USE OF THE ALAKSEN NATIONAL WILDLIFE AREA BY WATERFOWL, 1973-1987

John P. Hatfield

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ABSTRACT

Use by waterfowl of the Alaksen National Wildlife Area between 1973 and 1987 is presented. Thirty-four species of waterfowl were seen in and around Alaksen, of which five species are the main beneficiaries of management operations. They are Lesser Snow Goose (Chen caerulescens), Canada Goose (Branta canadensis), Mallard (Anas platyrhyncos), Northern Pintail (A. acuta) and American Wigeon (A. americana). Historical information both before and after the establishment of Alaksen is given. Dates of fall arrivals, spring departures and numbers of waterfowl on Alaksen are presented. Various crops and management operations in relation to their importance to waterfowl use are discussed as are field habitats, predators, numbers, and social behaviour. Future management and research options are presented.

RESUME

Ce rapport traite de la fréquentation de la réserve nationale de faune d'Alaksen par les oiseaux aquatiques entre 1973 et 1987. On a observé trente-quatre espèces d'oiseaux aquatiques à Alaksen et dans les environs, dont cinq espèces sont les principaux bénéficiaires des activités d'aménagement: la petite oie blanche (Chen caerulescens), la bernache de Canada (Branta canadensis), le canard mallard (Anas platyrhyncos), le canard pilet (A. acuta) et le canard sifleur d'Amérique (A. americana). L'auteur fait le point sur les périodes précédant et suivant l'inauguration de la réserve Alaksen. Il donne les dates d'arrivée, en automne, et de départ, au printemps, des oiseaux aquatiques, ainsi que le nombre d'oiseaux. L'importance internationale de la réserve Alaksen comme aire de repos et gîte d'hivernage a été prouvée par le comportement des oiseaux aquatiques marqués. L'auteur traite des diverses cultures et des activités d'aménagement qui influencent les oiseaux aquatiques, de même que des habitats, des prédateurs, du nombre d'oiseaux et de leur comportement social. Finalement il présente les options futures pour l'aménagement et la recherche.

TABLE OF CONTENTS

	Page
Abstract	i
Resume	ii
List of Tables, Figures and Appendices	iv
Acknowledgements	vi
I. Introduction	1
1. Historical background	1
2. Methods	5
II. Results	6
1. Roosting and feeding sites	6
2. Tides and weather	7
3. Field crops	9
a. Forage	9
b. Fall rye	10
c. Sprouting grain	11
d. Potatoes	11
e. Corn	12
4. Field habitats	12
5. Migration movements	14
6. Waterfowl responses to field management	15
7. Interspecies interactions	17
8. Grazing behaviour	18
a. Canada Geese	18
b. Wigeon	18
c. Lesser Snow Geese	19
9. Disturbance factors	19
a. Predators	19
b. Aircraft	21
c. Vehicles and humans	21
III. Discussion	21
IV. Recommendations	23
Literature Cited	25

LIST OF TABLES, FIGURES AND APPENDICES

Tables — Page

Table 1. Chronology of events relating to migratory Lesser Snow Geese at the Alaksen National Wildlife Area, 1980 to 1987 27

Table 2. Chronology of events relating to Canada Geese and field-feeding ducks at the Alaksen National Wildlife Area, 1980 to 1987 28

Table 3. Changes in hectares of various crops planted at the Alaksen National Wildlife Area, 1974 to 1986 29

Table 4. Dabbling duck-days of use at the Alaksen National Wildlife Area by year and fields, 1980 to 1986. 30

Table 5. Dabbling duck-days of use at the Alaksen National Wildlife Area, 1980 to 1986 32

Table 6. Monthly dabbling duck-days of individual field use at the Alaksen National Wildlife Area, from 1980 to 1986, by species. 33

Table 7. Total bird-days of individual field use at the Alaksen National Wildlife Area, by species, from 1980 to 1987. 35

Table 8. Use of fields in the Alaksen National Wildlife Area by waterfowl, 1980-87, expressed as birds per hectare per year. Use of individual fields is shown, and average use of fields #4, #5 and #6 which were used to pasture livestock until late summer, and fields 3 and 15 where hay was consistently cut . . 36

Table 9. Fall and winter use, by dabbling ducks, of fields #8 and #9, on the Alaksen National Wildlife Area, during the period 1980-85 when the fields were not flooded, and the period 1985-87 when the fields were flooded 37

Table 10. The average numbers of dabbling duck-days per month, counted on Alaksen from 1980 to 1987 38

Figures

Figure 1. The foreshore of the Fraser River Delta from Point Grey to Point Roberts. 40

Figure 2. The Alaksen National Wildlife Area and George C. Reifel Migratory Bird Sanctuary. 41

Figure 3. Use by geese of fields 1 to 15, 1980-1981 42

Figure 4. Use by geese of fields 1 to 15, 1981-1982 42

Figure 5. Use by geese of fields 1 to 15, 1982-1983 43

Figures (cont'd) Page

Figure 6. Use by geese of fields 1 to 15, 1983-1984 43

Figure 7. Use by geese of fields 1 to 15, 1984-1985 44

Figure 8. Use by geese of fields 1 to 15, 1985-1986 44

Figure 9. Use by geese of fields 1 to 15, 1986-1987 45

Figure 10. Annual average use by geese of fields 1 to 15, from 1980 to 1986. 45

Figure 11. Annual use of all fields combined, by geese from 1980 to 1986. 46

Figure 12. Annual average use of field 1 by geese per month, from 1980 to 1986 47

Figure 13. Annual average use of field 2 by geese per month, from 1980 to 1986 47

Figure 14. Annual average use of field 3 by geese per month, from 1980 to 1986 48

Figure 15. Annual average use of field 4 by geese per month, from 1980 to 1986 48

Figure 16. Annual average use of field 5 by geese per month, from 1980 to 1986 49

Figure 17. Annual average use of field 6 by geese per month, from 1980 to 1986 49

Figure 18. Annual average use of field 8 by geese per month, from 1980 to 1986 50

Figure 19. Annual average use of field 9 by geese per month, from 1980 to 1986 50

Figure 20. Annual average use of field 14 by geese per month, from 1980 to 1986 51

Figure 21. Annual average use of field 15 by geese per month, from 1980 to 1986 51

Appendices

Appendix 1. Waterfowl species observed on the Alaksen National Wildlife Area. 53

Appendix 2. Bird-days of individual field use at the Alaksen National Wildlife Area, from 1980 to 1987, by month and species. . . 54

Appendices (cont'd) Page

Appendix 3. Information from field notes. 57

Appendix 4. Maps showing field crops from 1974-1987 68

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I. INTRODUCTION

The purpose of this report is to review waterfowl use and management of the Alaksen National Wildlife Area (NWA). Historical and present day waterfowl use is discussed. Future management and research needs are recommended. Some of the quantitative data are included for record purposes only. Data on field crops, forage, and their management, were presented in greater detail in Hatfield (1987).

The management plan for Alaksen states that "The basic management strategy will permit, as appropriate, the active intervention of man to achieve desired wildlife management objectives and benefit of wildlife, fish and plant species" (Canadian Wildlife Service, 1986 [CWS]). That strategy, applying to both the Alaksen NWA and the contiguous George C. Reifel Migratory Bird Sanctuary (MBS), will primarily maintain or enhance a high quality habitat complex for estuarine wildlife species. Emphasis will be on the provision of staging and wintering habitat for migratory birds and year round habitat for resident birds. The bird checklist for Alaksen shows 227 species known to occur on Westham and Reifel islands. Most were seen within the NWA and the MBS.

The Fraser River estuary (Fig. 1) is widely recognized as a major staging and wintering area, of international significance, for thousands of migratory waterfowl, thirty-four species of which visit or are resident on, the Alaksen NWA and the George C. Reifel MBS (Appendix 1). Five of those species are far more abundant than the others, and they are the main beneficiaries of management operations (Weber 1982, Kragh 1983 and Hatfield 1987). They are Lesser Snow Goose (Chen caerulescens), Canada Goose (Branta canadensis), Mallard (Anas platyrhyncos), Northern Pintail (A. acuta) and American Wigeon (A. americana).

1. Historical background

The historical background of the Alaksen NWA and George C. Reifel MBS was detailed by CWS (1986). The following is a brief summary of significant events leading up to the formation of the NWA. In 1961 a group of far-sighted

people met to form the British Columbia Waterfowl Society. That Society is dedicated to waterfowl and waterfowl habitat conservation. They, in turn, persuaded the Provincial Government in 1963 to set aside 283 ha of foreshore, off Westham Island, as a game reserve. The Government of Canada was also consulted, resulting in the formation of the George C. Reifel Migratory Bird Sanctuary, covering the same general area as the Provincial game reserve (Fig. 2).

In 1972, the CWS of Environment Canada acquired by purchase and donation the holdings of George H. Reifel on Westham Island. That land consisted of 276 ha of farmland and formed the nucleus of what is now the Alaksen NWA (Fig. 2). It is located approximately 20 km south of the city of Vancouver, British Columbia and, together with the provincial game reserve, has been preserved for the conservation and management of migratory birds (CWS, 1986).

Before the establishment of the George C. Reifel MBS and the Alaksen NWA, migrating waterfowl had virtually no protection from habitat destruction or hunting pressure on the Fraser estuary. Throughout the hunting season they had to roost out at sea during daylight and feed at night on the foreshore or fields, sometimes causing crop depredation, or move further south. Also, the general public had no opportunity to observe wintering waterfowl on Westham Island.

Migrating Lesser Snow Geese and Canada Geese usually made fall stopovers along the Fraser estuary but headed further south shortly after the opening of the hunting season. They returned in the early spring for short stopovers before heading north during mid- to late April (R. Husband, pers. comm.). On the other hand, wigeon usually arrived about mid-October and remained for the rest of the winter, unless there was a long cold spell with snow. That behaviour is due to their ability to field-feed at night, thus avoiding hunting pressure and some of the more active daylight predators.

With the formation of the Reifel Sanctuary, and later the Alaksen NWA, came protection of foreshore and upland habitat from hunting pressure. There was now a place for migratory and resident waterfowl to rest and feed, and an

opportunity to alleviate crop depredation on Westham Island farms.

What has become one of the more spectacular annual migrations onto Alaksen and neighbouring farms, is the fall, winter, and spring staging of Snow Geese. Migrating Canada Geese, on the other hand, have not been attracted in such large numbers. The numbers of wigeon vary considerably throughout the winter, depending on the weather and availability of feed. However, because of their mainly nocturnal field-feeding habits, on neighbouring farms especially during the hunting season, they are less conspicuous to the casual observer. According to R. Husband (pers. comm.) the numbers of wintering wigeon increased dramatically following the introduction of fall rye as a cover crop in the mid 1960's.

Before 1980, migratory Snow Geese would field-feed in the fall on private farms on Westham Island if a sudden freeze occurred or if there was a big increase of immature Snow Geese. However, the returning Snow Geese have always grazed in the fields during their short spring migration stopovers on Westham Island (R. Husband, pers. comm.).

Between 1973 and 1979, migrating Snow Geese came into Alaksen to field-feed only once, in March 1977, although they were present on the foreshore every year (Appendix 3). They were not seen on the NWA again until 1980. In contrast, during that period migratory Canada Geese and wigeon were regular fall and winter visitors to the NWA, feeding primarily on sprouting grain and fall rye. No numbers of Canada Geese were recorded, but it was unusual to see more than 1000 at any time. Before 1980, early fall migratory Mallards and Northern Pintails fed mainly on barley, which was the predominant crop grown on Alaksen then.

In 1965, the B.C. Waterfowl Society, as part of their endeavour to display as many species of North American waterfowl as possible, obtained 60 Lesser Snow Geese, originally from Hudson Bay colonies, which were surplus to a research program in Ontario. Those geese were free flying. They bred on the George C. Reifel MBS but did not migrate. They fed on Alaksen fields and neighbouring farms during the 1970s and into the early 1980s, when their numbers declined considerably. On October 4, 1982 my field notes state "15

refuge snows on field #15". That was the last record of the "refuge snows", and their fate is unknown. We initially thought that the presence of the "refuge snows" might encourage the migrating Snow Geese onto the various fields with them. That did not occur, however, perhaps because they were 'foreign' to the migrating Snow Geese, with quite different vocalizations.

Another project of the B.C. Waterfowl Society was the introduction of Canada Geese to the lower Fraser Valley. On May 31, 1967 the first pair of Canada Geese, and two extra males, were released on the Reifel Sanctuary. More Canada Geese, from various sources, were added that summer. By September 1967, there were 23 pinioned Canada Geese on hand.

The first brood of 4 young Canada Geese hatched May 23, 1968 on the Reifel Sanctuary. More adults from Stanley Park were added to that collection later in 1968. In the spring of 1969, 13 refuge-hatched young, plus 12 more flying birds from Stanley Park, increased the total of free-flying birds to 47. By 1971, the total number of free-flying geese was 101. In 1972, approximately 170 goslings hatched from 35 nesting pairs. In 1973, 65 pairs raised 270 free-flying young. By 1974, approximately 300 free-flying young were raised. By December of 1974, there were over 800 free-flying Canada Geese on the Reifel Sanctuary. From 1974 to 1977, the resident flock remained at about 800, because of the removal of eggs and young for a Canada Goose introduction program for the Fraser Valley. In 1978, 500 eggs were collected from the Reifel Sanctuary for the Canada Goose program. During most of that period, the hunting season on Canada Geese was closed in the Fraser Valley to allow their numbers to increase to an acceptable level: that is, one where they could not be wiped out by hunting, nor cause unacceptable depredation to farm crops. The hunting season was reopened (for the first time since the 1973-74 season) from October 23 to November 12, 1978 with a one bird per season bag limit. Subsequently, the bag limit was raised to 2 birds per day (4 per year) and the hunting season was extended to correspond to that for all waterfowl in the Lower Mainland Region. For the 1986-87 season, that was October 11, 1986 to January 25, 1987.

2. Methods

From the fall of 1980 through the spring of 1987, I systematically observed and recorded the number of waterfowl field-feeding on Alaksen NWA. I started my counts each fall when the Canada Geese settled into their general field-feeding pattern (usually late August) and continued them until the last half of March the following year. I usually counted birds three times per week, during the Canada Goose morning feeding period, on fields #1 through #6, #8, #9, #14 and #15 (Fig. 2). Count routes followed existing dykes and roads, and took approximately 90 minutes to complete by vehicle and two short walks (Fig. 2). Results are presented in Tables 1, 2, 4 through 10, Figs. 3 through 21, and Appendix 2.

No data are included in this report for waterfowl use of fields #7, and #10 through #13 (Fig. 2). Field #7 is a small treed area and is not used by waterfowl except for some nesting. Waterfowl using fields #10 through #13 were counted by the staff of BCWS. However, because their counts were not systematic and were not kept separate by fields, I did not use them.

I sometimes could not carry out regularly-scheduled counts because of fog or other duties. All counts used in this report were full counts on census day. Partial counts (e.g. due to fog) were discarded. I estimated the number of birds present on days when counts were missed by using linear interpolation between the two nearest days for which counts were done. For statistical purposes, I assumed that no waterfowl were on Alaksen before the first survey in the fall nor after the last one in the spring.

Migratory Lesser Snow Geese have been neck collared for easy identification in the USSR, the USA, and at Alaksen. Their movements, and those of other marked and banded waterfowl, have demonstrated the international importance of the Fraser estuary as a wintering and staging area. Reference to observations of movements of marked waterfowl, particularly local movements, are used throughout this report. Unless specified, no distinction is made between migrating or resident Canada Geese throughout this report, as they are difficult to tell apart in the field by appearance alone. Migratory geese, however, tend to be more wary of humans than the resident birds.

Blue-winged Teal (Anas discors) and Cinnamon Teal (A. Cyanoptera) were not included in my counts because they left for southern wintering areas each fall before my counts began and returned each spring after my counts ended.

Green-winged Teal (A. crecca) are present on Alaksen NWA throughout the winter. They were only observed in the flooded fields or in and around standing water. It is very difficult to get an accurate number of Green-winged Teal due to their small size and constant movements in and out of any vegetation present. Therefore I did not include them in my counts.

Other waterfowl, such as divers, are casually mentioned in this report as they are not field-feeders, and appear in low numbers and/or sporadically from one year to the next (Appendix 1).

II. RESULTS

1. Roosting and feeding sites

According to Owen (1973), "It is essential to have suitable feeding grounds reasonably close to a safe roosting place", and that is certainly the situation for waterfowl on Alaksen. Both Canada Geese and wigeon roost overnight, and often during the day, on Ewen and Fuller sloughs (Fig. 2), as well as on the foreshore. The resident Canada Geese favour those sloughs, whereas the migrating Canada Geese roost on the foreshore off Westham Island. Mallards and Northern Pintails also roost on those sloughs. Small numbers of various species of divers use the sloughs for both roosting and feeding. One diver species that is a consistent winter resident of the Alaksen NWA is the Bufflehead (Bucephala albeola), numbering up to 50+ individuals on a given day.

The sloughs may be used by some waterfowl because they are sheltered or convenient to food. They may also be favoured because they are relatively fresh, as shown by salinity readings taken weekly throughout 1985. The mean salinity taken at two points, approximately 15 to 20 cm below the surface, for

Ewen Slough are 3.026[1] and 3.881, respectively. The mean salinity for Fuller Slough taken at two points, approximately 15 to 20 cm below the surface, are 2.611 and 2.233, respectively. In contrast, the mean salinity from a sampling point on the foreshore opposite field #12 was 10.1 (Hatfield, 1986).

Snow Geese, on the other hand, use the foreshore for nocturnal roosting and possibly feeding, and the two sloughs on Alaksen for diurnal roosting and drinking, particularly during October and early November before the fields begin to hold standing water from fall and winter rains. Snow Geese did not start to use the sloughs until November of 1984, but have done so since. Observations of collared Snow Geese show the average distance flown from foreshore roosts to Alaksen's fields is 3-4 Kilometers. The farthest known distance is 12 Kilometers, from Sea Island (Fig. 1). From collar observations, I determined that the same Snow Geese stayed in the vicinity of Alaksen from November 5, 1986 to January 19, 1987 before moving south to the Skagit Valley. More information on length of stay and turnovers will be available with future collar observations. Family groups were also collared, providing opportunities to observe family traits.

2. Tides and weather

"The fluctuating tides of the Fraser foreshore have a dominating effect on the daily activity pattern of the Lesser Snow Geese" (Burton 1977). Tides also affect the field-feeding behavior of wintering Snow Geese on Alaksen and neighbouring farms.

Work by Burgess (1970) and Burton (1977) determined that bulrushes (Scirpus americanus and S. paludosus), the primary food plant of Snow Geese on the Fraser foreshore, grew between 2.1 m and 3.5 m tide elevation. Burton further stated that most feeding occurs when the water level is between 10 cm below the minimum and 20 cm above the maximum elevation ranges of those plants. As a result, the social inducement to leave the feeding grounds along the foreshore is high when the water is above or below those levels.

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1. Salinities were determined using a S-C-T Meter (Yellow Springs Instrument Co.). Readings are in parts per thousand.

The Snow Geese generally fly out to field-feed from their foreshore feeding and/or roosting sites when the incoming tide has reached the 3.6 m elevation during daylight, up to an hour before sunset. They do not remain in the fields overnight, but usually fly en masse to the foreshore about one-half hour after sunset. That pattern is changed abruptly when there is stormy weather. Then the Snow Geese fly to the fields at daybreak and remain all day regardless of the tides or an abating storm. Their evening return flight to the foreshore is sometimes changed because of light intensity (e.g. overcast vs. clear) or various disturbances. Disturbances are discussed later.

Snow Geese generally field-feed on Alaksen during the hunting season (Table 1, Figs. 3 to 21, and Appendix 2). During the period between the two hunting seasons[1], from the end of November to the third week in January, or during a lull in hunter activity, their field-feeding pattern may change. They tend to remain out on the foreshore during calm weather, when the diurnal high tides have only one peak per day.

Canada Geese on Alaksen generally have set field-feeding patterns regardless of tides or weather. They have a morning feeding period, then return to the foreshore or Ewen and Fuller sloughs for drinking and midday rest. They return to the fields several hours before sunset for their evening feeding period. During December through to March, however, they remain in the fields all day as there is standing water available for drinking.

Wigeon, noted for their nocturnal field feeding behaviour, along with Mallards, and Northern Pintail also feed on the fields of Alaksen during the diurnal period. That is especially evident during stormy or cold weather. Interaction between grazing waterfowl will be discussed later.

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[1] There is a split season for Snow Geese on B.C.'s Lower Mainland. For example, in 1987-88, it was October 10-November 29, 1987 and January 16-March 10, 1988.

3. Field crops

On Alaksen, field crops grown for wintering waterfowl are, in order of preference, forage, fall rye, sprouting grain, potatoes and corn (Hatfield 1987; Table 3). Appendix 4 provides maps of field crops grown 1974-1987.

Since the beginning of farming on Westham Island, there have always been grazing opportunities for wintering waterfowl. From the 1900's to the 1930's the field crops on the Island were grain and hay. Then from the early 1930's root crops, such as turnips, and potatoes were introduced. Gradually, in the forties and fifties, other types of vegetables, such as peas and cabbages were planted. Although a large selection of vegetables are now grown, there are still small parcels of hay and pasture. Also, for the past 20 years, it has been traditional for Westham Island farmers to plant fall rye following the vegetable harvest, to provide organic material to the soil in the spring (R. Husband, pers. comm.).

(a) Forage

The forage crops on Alaksen are grown to provide the highest carrying capacity possible for wintering waterfowl. They are fertilized as indicated by soil analysis.

The hectares of forage available to grazing waterfowl on Alaksen has varied from 20 in 1975, to 74 in 1981 and 1982, to 65 in 1986 (Table 3). The structure of the forage crops was changed from a mixture of climax timothy, kentucky bluegrass, creeping red fescue, meadow fescue and red top grass during 1975 to 1981, to a mix of sterling orchardgrass, tetraploid perennial ryegrass and ladino white clover in 1981 and later. The latter mixture is better suited to the growing conditions found on Alaksen than earlier crops (Bertram 1977, Hatfield 1987).

Livestock are pastured on fields #4, #5 and #6 from April 1st to September 30th annually, while fields #3 and #15 are cut for hay or silage by that time. Forage thus has time to grow for two weeks to a month before migratory geese and wigeon arrive. When average use per hectare is calculated (Table 8), it is seen that 74% more geese use the cut fields than the fields

grazed by livestock. Use by all dabbling ducks is about equal for the two treatments, although wigeon appear to favour pasture. All the forage crops are plowed under every 7 to 8 years for rejuvenation. They are seeded to an annual crop that year, then seeded with fall rye for winter grazing, and then seeded back to forage the following year. Resident Canada Geese, being few in number, have little impact on the forage crops.

Snow Geese, being gregarious, usually concentrate on one field until it is depleted of palatable food, and they have to move on. Despite that concentrated grazing, forage crops will grow back again to a viable crop the following spring. Fields of 8 to 12 hectares, on Alaksen, will hold approximately 14,000 Lesser Snow Geese for 7 or 8 consecutive days, provided there are no major disruptions. In total, Alaksen forage and fall rye crops (100 hectares) can provide approximately ten weeks of grazing opportunity for 14,000 Snow Geese, or 980,000 goose-days per winter, based on figures from the winter 1985-86 (Table 3 and Fig. 8).

Smartweed (Polygonium sp.) grows in the low moist areas of fields #3, 4, 5 and 6. Following heavy winter rains, large numbers of Mallards, Northern Pintails, Green-winged Teal and wigeon concentrate on those wet areas to feed on the floating smartweed seeds and other seeds (Tables 4 to 7 and Appendix 2).

(b) Fall rye

On Alaksen, fall rye is seeded in fields #1, #2 and #14 which, in turn, provides ample grazing for wintering waterfowl (Hatfield 1987). The seeding times for those three fields are staggered to provide green vegetation of various heights. It is important to provide some tall plants to ensure availability of vegetation in case of snow. As the snow melts, the birds graze down the protruding vegetation. Fall rye continues to grow throughout mild winter months and so also, to a lesser extent, does forage. During freezing weather, which is infrequent in the lower Fraser valley, forage and fall rye stop growing.

Wintering Canada Geese, wigeon and Lesser Snow Geese graze on fall rye on Alaksen and neighbouring farms. On Alaksen, Snow Geese generally graze out forage crops first before moving on to fall rye or other crops. The Snow Geese migrate further south from approximately the last week of January, returning in late February or early March (Table 1), thus enabling the forage and fall rye to recover with new growth for early spring grazing.

The significance of fall rye as a winter food source for wigeon cannot be overlooked. The lowest number of hectares in fall rye on Alaksen occurred in 1981 with the corresponding lowest number of wigeon-days. The highest number of hectares in fall rye occurred in 1984 with the corresponding highest count of wigeon-days on Alaksen (Tables 3 and 5).

(c) Sprouting grain

In recent years, barley was usually grown on 6 to 12 hectares on Alaksen to alleviate crop depredation on neighbouring farms by migrating Mallards and Northern Pintails (Hatfield 1987, Table 3). A portion was left standing, while the rest was swathed to encourage ducks to feed on it. There is much spillage of grain kernels in both cases, resulting in sprouting, which in turn attracts grazing waterfowl. The Snow Geese will graze on the sprouting swathed barley in the fall, but not the standing barley unless there are large areas lodged providing additional sprouting barley. Most standing barley has been flattened by early spring, and it was in such a situation that the first observations of grazing on sprouting barley by Snow Geese at Alaksen were made in spring of 1977.

(d) Potatoes

Potatoes, high in carbohydrates and easily digested, are a good source of food for several species of waterfowl. During harvesting operations, potatoes are culled in the field and the culls left on the ground become available to the birds. Following a frost, potatoes are much easier for waterfowl to eat as they become mushy after thawing. Snow Geese, Mallards, and swans[1] have

1 - Swans (both Trumpeter and Tundra) did not start feeding on potatoes on Alaksen until 1988.

been observed feeding on potatoes on Alaksen and neighbouring farms. Due to their ability to "grub", Snow Geese and swans will also feed on unharvested potatoes. Twenty to 28 hectares of potatoes are grown annually on Alaksen (Hatfield 1987).

(e) Corn

A high-yielding corn crop will provide food for several thousand waterfowl, such as Mallards, Northern Pintails and Canada Geese, over a long period of time. Two to 8 hectares of silage corn were planted annually on Alaksen, except during the years 1979, 1984 and 1985 (Hatfield, 1987 and Table 3). The reason for silage corn is that Raccoons (Procyon lotor) will eat sweet corn but ignore silage corn. The corn is left standing, eventually being knocked over by wind and rain, generally by December. Only a small number of Snow Geese have been observed in chopped and/or downed corn.

4. Field habitats

Field #15 (14 ha, Fig. 2), because of exceptional use by Snow Geese and dabbling ducks, received greater use by total waterfowl than any other field (Tables 7 and 8). Resident Canada Geese graze on it the year round, except when Snow Geese are using it in the fall. Field #15 is one of the closest fields to the foreshore roosts. Also, Fuller and Ewen sloughs, on either side of it provide adjacent roosting and drinking sites. The south side of the field is mainly open to Fuller Slough, providing particularly easy access, while the north side, next to Ewen Slough, has trees and shrubs along its entire length. Waterfowl will fly over the trees to get at the forage. Field #15 provides the public with an opportunity to view grazing waterfowl from the George C. Reifel MBS.

Field #5 (12 ha), not a heavily used field compared to most others (Table 8), provides easy access for waterfowl from Ewen Slough, as there are few shrubs along its south side. The field was in forage and was grazed by livestock in summer during the study period except during 1985 to 1987 when it was seeded to barley and faba beans. Occasionally, Snow Geese fly from

foreshore roosts into Ewen Slough before going on to fields #4, #5, #6, and #15, or into Fuller Slough before flying to fields #14 and #15.

Fields #4 (8 ha) and #6 (19 ha) are almost completely surrounded by trees and shrubs. They are, however, wide-open fields which makes them attractive to both geese and dabbling ducks (Tables 7 and 8, Figs. 10, 15, and 17, Appendix 2). Wigeon use field #4, on a per hectare basis, much more heavily than others, with fields #6 and #14 being their next choices among fields with crops and standing water (Table 8). Field #4 was not, however, favoured by Mallards (Table 8). The western half of field #6 has been allowed to grow up in Juncus sp. That discourages feeding use by geese as Juncus grows to a height of approximately 80 cm. Owen (1973) found that White-fronted Geese (Anser albifrons) avoided Juncus areas at Slimbridge, England. Alaksen's resident Canada Geese will sometimes nest in Juncus.

Fields #8 (8 ha) and #9 (12 ha) are flooded each winter with tidal waters from the Fraser River. When flooded, they attract thousands of dabbling ducks, particularly Mallards and wigeon (Hatfield 1986; Tables 4, 5 and 9). The use of those two fields by dabbling ducks increased by an astonishing 1900% since the practice of flooding them began in 1985 (Table 9). Field #8 is the most popular with Northern Pintails and wigeon, while field #9 is the most popular with Mallards (Tables 8 and 9). Snow Geese have not been observed in those fields (Figs. 3 to 10). Field #8 is completely surrounded by trees, except for a small opening in the southwest corner. Canada Geese like to roost and graze on a levee, along the southeastern side of #8 field, which was built in 1984 to enable the flooding of both fields. Field #9, completely surrounded by dykes, is open except for a few scattered coniferous trees along the western, or foreshore, side and two rows of coniferous trees along the entire eastern side. Approximately three quarters of that field is covered with dense, scattered clumps of Reed Canary Grass (Phalaris arundinaceae), growing to heights of 160 to 180 cm. Canada Geese avoid such areas, and only a few use the open water areas and the less densely vegetated north end of the field. Snow Geese have not been seen to use field #9 at all (Tables 7, 8, Figs. 3 to 10, 19 and Appendix 2).

Fields #3 (14 ha) and #14 (20 ha) are mostly surrounded by high Red Alder (Alnus rubra) trees. Those two fields (and #15) are the most popular with Canada Geese (Tables 7 and 8). Waterfowl can be observed on both fields by the public from nearby roads.

In fields #1 (28 ha) and #2 (12 ha), as many as 10 to 15 thousand Snow Geese sometimes provide spectacular closeup viewing for the public from the comfort of their vehicles. Generally they are the last fields that Snow Geese feed on before moving onto neighbouring farms, usually within a few days following the close of the first hunting season. Both those fields have little cover around their edges, and they are used lightly, relative to most other fields, by dabbling ducks and Canada Geese (Tables 7 and 8). Still, they offer the best public viewing of waterfowl at Alaksen.

Fields #11 (12 ha), #12 (6 ha) and #13 (4 ha), are natural grasslands with a few shrubs. They provide nesting habitat for ground nesting birds, but waterfowl do not use them in significant numbers (John Ireland, pers. comm.). Field #10 (8 ha) is cultivated in the spring, and then flooded in the winter months resulting in an increase in use by waterfowl, similar to fields #8 and #9 (John Ireland pers. comm.).

5. Migration movements

Generally, Snow Geese arrive in the vicinity of Alaksen in early October and stay until late January, then move to the Skagit Valley in the State of Washington approximately 110 kilometers south of Alaksen. They return to the Fraser estuary in early March and depart for northern nesting grounds in late April (Table 1, Appendix 2). The first Northern Pintails and Mallards start to field-feed on Alaksen from mid- to late September and remain until late March to mid- April (Tables 2, 6, 10, Hatfield field notes). The peak Northern Pintail migrations are during September/October and January with very few remaining in November and December. Peak migrations for Mallards are during October and January with considerable numbers of birds overwintering (Table 10). Meanwhile, wigeon start to field-feed on Alaksen in significant numbers by mid-October with their numbers remaining stable until February

(Tables 2, 6 and 10). The fall flights are going south, while the January to March flights are of birds returning to their northern breeding grounds. The decrease in numbers of dabbling ducks in February on Alaksen is a direct result of the hunting season closing on the last weekend of January for ducks and Canada Geese, which enables them to disperse to other parts of the Fraser Valley (Tables 2 and 10).

6. Waterfowl responses to field management

Besides being attracted to flooded fields, Mallards, Northern Pintails and/or wigeon are also attracted to fields that have been planted to potatoes, corn, faba beans or barley (see years 1980 and 1984 in Table 4 and Appendix 2 and 4). Usually the first three of those crops would provide the most bird-days of feeding, spread over a long period, compared to a field of barley, which could be cleaned out in one night (Hatfield 1987). In some instances, those ducks fed on the crops at night to avoid hunters from neighbouring farms, such as happened in 1982 on field #1 (Hatfield 1987, Hatfield field notes). Thus, my systematic morning counts showed no dabbling duck use (Table 4, Appendix 2), but by the time the hunting season closed, those crops were eaten out (Hatfield field notes), either by nocturnally-feeding ducks or diurnally-feeding geese.

In another example showing the dramatic effects of crop rotation, the 1980 crop in field #14 consisted of potatoes, fall rye, corn and faba beans, with a corresponding 97,250 dabbling duck-days. In 1985, the crop on this same field was seeded to fall rye following the harvest of peas and beans and received only 200 wigeon-days use. At the same time, fields #8 and #9 were flooded and attracted 73,285 dabbling duck-days. Field #14, however, did have a total of 78,162 goose-days in 1985 (Table 4, Fig. 8, Appendix 2 and Hatfield 1987). Although fields #1 and/or #2 showed no dabbling duck-days in the years 1982, 1985 and 1986, they did receive many goose-days of use (Figs. 4, 7, 8, Appendix 2).

Standing water plays an important role in attracting dabbling ducks to both cultivated fields and pasture (Baynes 1953, Hirst and Easthope 1981,

Eamer 1985, Hatfield 1987, Hatfield field notes). If there is standing water in a field, most dabbling ducks, including smaller numbers of Gadwall (Anas strepera) and Northern Shoveler (Anas Clypeata), are either on the water or in its immediate vicinity. All the fields on Alaksen accumulate some standing water from heavy winter precipitation November through March. That provides both ducks and geese with drinking water, enabling them to remain on a field throughout the day.

Apparently there are several factors involved in making a pasture attractive to dabbling ducks. Field #6, which was in pasture throughout the study period, 1980 to 1986 is a good example. There was a general increase in dabbling duck-days, except for 1985 when fields #8 and #9 were flooded for the first time (Table 4). It was noted that standing water generally remained longer in #6 field as it aged, possibly due to the soil structure tightening up over time (annual cultivation keeps the soil structure loose). Also, as forage fields mature, perennial plants such as Juncus sp. become established, along with the annual smartweeds, providing a possible food source in the form of seeds (Hatfield 1987).

Field #6 carried more dabbling ducks in March than all the other fields combined during the study period (Table 6). That is probably due to a combination of several factors. Firstly, the non-forage fields, with their annual crops, have been eaten out by that time. Secondly, perennial and annual seeds are readily available with easy access from plenty of standing water due to heavy March rains. Thirdly, livestock were pastured in this field during the study period. I suspect their manure may provide shelter or a reproductive medium for several species of insects. The eggs and/or larvae would be washed out by heavy rains, from the forage and/or manure and into standing water, to become readily available as food for wintering waterfowl. Fourthly, unlike other fields on Alaksen, field #6 held many small areas of standing water rather than one or two large areas. I believe that increased the "edge effect" to the benefit of waterfowl. Fifthly, the other forage crops, being younger, would have been heavily grazed earlier in the winter by

Snow Geese and wigeon and would have very few perennial plants, if any.

Hirst and Easthope (1981) reported that of the pasture-feeding dabblers they sampled in the Serpentine-Nicomekl lowlands, species food preferences were: Green-winged Teal - seeds; Northern Pintails - seeds and invertebrates (primarily insects); Mallards - seeds and green vegetation; and American Wigeon - green vegetation. Presumably, those preferences are also valid for those species on Alaksen's pastures.

7. Interspecies interactions

When Snow Geese and Canada Geese are in the same field, there is little intermixing. The more numerous Snow Geese cover large areas leaving little open space for any other geese present in the same field. Generally, when the Snow Geese start grazing on a field, the Canada Geese move to another field. When the Snow Geese have grazed out a field, they follow the Canada Geese to the next field. Most Snow Geese almost always graze together in large flocks. The exceptions are injured birds and some family groups that remain on fields #5 or #15 within easy reach of water. By contrast, most resident Canada Geese graze in small scattered flocks in the same field, but there are also other small flocks simultaneously feeding on other fields. I suspect that some of those 'other' flocks of Canada Geese are fall and winter migrants. Based on goose-days, whenever the annual numbers of Snow Geese increased, the numbers of Canada Geese decreased on Alaksen (Fig. 11).

Wigeon, on the other hand, have feeding periods both night and day on Alaksen. There are always some present from October to April, even though their numbers vary widely between counts from field to field. I observed large numbers of wigeon when there was standing water available during daylight hours, either by themselves or intermingled with geese. When geese are present, wigeon prefer to graze with them rather than by themselves. Mallards, Northern Pintails, and Green-winged Teal also mix with the geese, especially when there is standing water available.

When livestock are present, Canada Geese will graze in the same field and, on occasion, wigeon will too. I have had no opportunity to observe the

interaction of Snow Geese and livestock because the livestock are removed from the pastures before the geese arrive each fall.

8. GRAZING BEHAVIOUR

(a) Canada Geese

About 400-500 resident Canada Geese routinely graze on Alaksen. Occasionally, flocks of 100-plus migrating Canadas stop there for short periods, particularly when the hunting season is open on surrounding areas. Hunting on nearby areas also affects the behaviour of resident Canada Geese. When the hunting season is closed, the resident Canada Geese generally graze on neighbouring farms in the morning and on Alaksen in the afternoon. However, during the pea-harvesting season (from early August to mid-September), the resident geese follow pea-harvesting crews and feed on waste peas. At such times they will fly as far as 14 km from Alaksen. During the hunting season (roughly October through January), most of the resident Canada Geese stay on Alaksen.

When on Alaksen, Canada Geese usually graze in the same general area of a field where they first landed. They walk slowly as they graze and avoid trees and shrubs by at least 6 m. Usually, Canada Geese are the quietest of the waterfowl that graze on Alaksen. However, in March the breeding pairs become noisy and aggressive as they establish and defend nesting territories.

(b) Wigeon

According to work by Burgess (1970) and Hirst and Easthope (1981), wigeon prefer green vegetation from fields, over seeds from the tidal marshes. Wigeon are both diurnal and nocturnal field-feeders on Alaksen. Although I made no nocturnal counts, I occasionally observed large flocks of wigeon landing on Alaksen's fields just at dusk.

Most field-feeding by wigeon however, appears to be diurnal on Alaksen, probably because of the low level of human disturbance there. Wigeon readily mix throughout grazing flocks of both Canada Geese and Snow Geese. When grazing in large flocks of their own species, they tend to feed in the more

open areas of the fields, especially near standing water. At such times they feed and advance together in a dense mass. They are very vocal while feeding.

Along with the large numbers of American Wigeon on Alaksen, a few Eurasian Wigeon (Anas penelope) occur at a ratio of approximately 1:1,000.

(c) Lesser Snow Geese

To the casual observer, the gregarious Snow Geese appear to be in one large flock as they graze in a field. However, closer observation reveals there are many smaller flocks within the main flock, consisting mainly of family groups, adult pairs, and non-breeding two and three-year-olds. There are numerous incidents of inter-group antagonism such as chasing and pecking. Unlike Canada Geese, Snow Geese will graze close to trees and shrubs along the edge of a field. They are forced to the field edges by their own large numbers and, in large numbers, they apparently feel safe from predators. Like wigeon, Snow Geese are very vocal while field-feeding. While the flock is feeding, some are resting and some adults are alert for any danger at all times. Some Snow Geese, both juveniles and adults, settle down to rest soon after they arrive on a field. That may be because some individuals fed on the tidal marshes before they left with the main flock for the fields.

While grazing, Snow Geese are very mobile--walking around, sometimes pulling up clumps of forage, or flying in small groups to the other side of the main flock to commence grazing again.

Feeding efficiency of young geese improves with age (Amat 1986). That may be the main reason large numbers of young Snow Geese converge on the forage and fall rye crops, the most easily obtainable food. Snow Geese that remain on the foreshore to feed are mainly adults.

9. Disturbance Factors

(a) Predators

Various predators either live on Alaksen or migrate through, so waterfowl are not completely free of disturbances while field-feeding. Wild predators are considered as an acceptable and natural part of the fauna on Alaksen and

are not removed.

Occasionally, coyotes (Canus latrans) are observed on Alaksen, however they have little impact on waterfowl. Coyotes, being opportunists, feed mainly on Townsend's Vole (Microtus townsendii), however feathers have been seen in their scats, presumably from crippled or dead birds. In the fall of 1986, I observed a coyote trotting into a flock of several thousand Snow Geese in field #6. Only those Snow Geese that were in a wide direct path of the coyote flew up and moved over to the other side of the flock. The coyote trotted into about half the flock, making no attempt to seize a Snow Goose before turning back from whence it came.

Raccoons play a direct role in controlling the resident waterfowl populations on Alaksen by eating their eggs, especially Canada Goose eggs. Waterfowl broods on the sloughs have another hazard with which to contend. R. Husband (pers. comm.) reported seeing Carp (Cyprinus carpio) eat Canada Goose goslings up to a week old. Presumably Carp may also eat ducklings.

I have never seen the resident Bald Eagles (Haliaeetus leucocephalus) and Red-tailed Hawks (Buteo jamaicensis) or wintering Rough-legged Hawks (Buteo lagopus) attack or harass healthy ducks and geese on Alaksen. However, any severely crippled or dead waterfowl are fed on by those three raptors. While raptors are feeding on a waterfowl carcass in a field, geese and ducks avoid that field. When Bald Eagles fly over a field occupied by Snow Geese, the geese fly off to one side in a large circle and then return behind the departing raptor. However, resident Canada Geese, while alert, remain on the ground as eagles pass over. I have seen smaller migrating raptors such as Peregrine Falcons (Falco peregrinus) and Northern Harriers (Circus cyaneus) flush ducks from a field, and occasionally attack an individual. At such times, geese are alert, but will not flush. However, wigeon grazing among the geese, will flush when a smaller raptor comes along. Burton (1977) reported the same general pattern.

Even though Great Blue Herons (Ardea herodias) are not waterfowl predators, they cause alertness and/or a short flight by ducks or geese when they fly near or over them. My records show that Snow Geese avoid herons on

the ground by about 9 m while field-feeding.

(b) Aircraft

I concur with Burton (1977) and Owen (1973) who stated that helicopters are extremely disturbing to geese which are either roosting or field-feeding. Small fixed-wing aircraft create considerably less disturbance, and large aircraft create no apparent disturbance at all. Vancouver International Airport is 10 km north of Alaksen and a flight path to Victoria is directly over the NWA, so I have many opportunities to observe such disturbances.

(c) Vehicles and humans

"Wild geese, like a majority of other wild animals, display considerable confidence with respect to various types of land-bound vehicles" (Burton 1977). That confidence is displayed by field-feeding waterfowl. Snow Geese are the easiest to approach by vehicle, as close as 15 m. Generally, the resident Canada Geese are less wary than are migrating Canada Geese--in some cases the latter have flushed more than 100 m from an approaching vehicle. Generally, ducks will flush further from an approaching vehicle than geese. Because of the unwary behaviour of Snow Geese on Alaksen, the public can often view them close-up from the comfort of their vehicles in Fields #1 and #2.

The Snow Geese are conditioned to the fact they are protected from hunting on Alaksen. I have often walked to within 10 m of Snow Geese before they have started to walk away. However, I made no threatening gestures and did not carry anything resembling a gun. It is often possible to get closer than 10 m if there is an intervening rail fence.

III. DISCUSSION

The Alaksen NWA is meeting one of its primary management goals: "to maintain or enhance a high quality habitat complex for estuarine wildlife species with emphasis on the provision of staging and wintering habitat for migratory birds" (CWS 1986).

By attracting large numbers of waterfowl to Alaksen, from September to

March, crop depredation to surrounding Westham Island farms is alleviated and opportunities for the public to observe wintering waterfowl have been considerably increased, especially for Lesser Snow Geese.

It is difficult to determine if Alaksen has reached its carrying capacity of wintering waterfowl, due to their dispersal in February and March. There are still a good number of waterfowl on Alaksen at that time and there is no doubt that the overall food source has greatly diminished. Fields have either been denuded or the fall rye is still short and pastures have been grazed down by waterfowl.

The Lesser Snow Geese benefit from the readily obtainable forage crops on Alaksen. With any gradual increase in numbers of waterfowl or decrease in alternative local habitat, Alaksen will be increasingly important for staging and feeding. Young geese become bonded to safe and profitable feeding areas such as Alaksen and will return with their broods to feed on those same areas. That eases the feeding pressure of numerous Snow Geese on their favourite foreshore foods of S. americanus and S. paludosus.

Wigeon and other migrating ducks have also taken advantage of Alaksen's staging and wintering habitat. Their numbers vary widely over the winter on Alaksen, due to weather conditions, so numerical trends from year to year are difficult to determine. With the increase in numbers of Trumpeter Swans (Olor buccinator) and Tundra Swans (Olor columbianus) wintering and field-feeding on Westham Island, Alaksen could become an important feeding area for those species as well.

Surface flooding of fields, either natural or artificial, has significant management implications for soils, vegetation and waterfowl. It was beyond the scope of this study to examine in detail those implications. However, some general observations were made. Field topography determines the depth, surface area, number of areas and drainage patterns, if any, of the flooded portions of a field. Weather and water table height are the determining factors of the longevity of standing water in a field. That in turn affects the vegetation in and around the flooded portions. The less water-tolerant crops such as fall rye and forage die out. On the pastures, the more water-

tolerant natural plants such as Juncus spp., Polygonum sp. and Bent Grass (Agrostis alba) take over.

The agricultural fields of Alaksen play an important role in attracting and holding wintering waterfowl as they provide a source of food and fresh water in close proximity to their roosting sites (Fig. 2.).

Standing water and/or flooded fields enable waterfowl to feed and drink with very little physical energy expended during the crucial winter months. Waterfowl fecal matter returns plant biomass and nutrients to the soil. Thus, by encouraging waterfowl to remain on a field, its organic content and fertility are improved. Only those fields in the immediate vicinity of sloughs, such as #5, #14 and #15, should be considered for surface drainage to increase their crop carrying capacity.

IV. RECOMMENDATIONS

Management

1. To accommodate as many staging and wintering waterfowl as possible, fields 1, 2, 3, 4, 5 (E 1/2), 6, 8, 9, 10, 14 and 15 should be maintained in their present size and crop regime.
2. To provide habitat for migratory passerines and both tree- and ground-nesting birds, fields 5 (W1/2), 7, 11, 12 and 13 should be left in their natural state.
3. To ensure optimum waterfowl food, the nutritional quality of crops grown on Alaksen should be periodically determined by analysis, and correlated with the nutritional requirements of waterfowl.

Predators

4. Exotic predators such as feral cats, dogs and carp should be removed when possible.
5. Coyotes should be reduced only when necessary to alleviate harassment of domestic livestock on neighbouring farms.

Research

6. Predators, particularly Raccoons, should be studied to determine their numbers, feeding habits, and impact on nesting and wintering waterfowl.
7. Research on the feeding and social behaviour of wintering waterfowl and shorebirds on Alaksen should continue.
8. Research on the feeding and social behaviour of passerines on Alaksen should continue.

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TABLES

Table 1. Chronology of events relating to migratory lesser snow geese at the Alaksen National Wildlife Area, 1980 to 1987.

Events	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
First geese noted	Oct.	Oct. 6	Oct. 21	Sept. 26	Oct. 8	Oct. 10	Oct. 10
First hunting season	Oct. 10	Oct. 10	Oct. 9	Oct. 8	Oct. 6	Oct. 12	Oct. 11
First field-feeding	Nov. 10	Oct. 19	Oct. 21	Nov. 10	Oct. 8	Oct. 16	Oct. 13
Total snows above date	54+	330+	700+	600+	5,900+	3,000+	3,000+
First hunting season closes	Dec. 1	Nov. 30	Nov. 30	Nov. 30	Nov. 25	Nov. 30	Nov. 30
Highest count on Alaksen	2,600+	14,000+	22,000+	8,000+	12,200+	14,000+	15,000+
Date of highest count	Jan. 8	Nov. 19	Oct. 27	Nov. 24	Nov. 2	Oct. 30	Oct. 27
Snows on neighbouring farms	Nil	Dec. 3	No observations	Nil	Nov. 28	Nov. 22[1]	Dec. 2
Last known date snows still in vicinity[2]	Jan. 28	Jan. 18	Feb. 14	Nov. 25[3]	Jan. 25	Jan. 22	Jan. 19
Snows return to Alaksen fields	March 4	March 11	March 3	Feb. 27	March 4	March 10	March 2[4]
Second hunting season opens	Jan. 28	Jan. 23	Jan. 23	Jan. 23	Jan. 19	Jan.18	Jan.17
Second hunting season closes	March 10	March 10	March 10	March 10	March 10	March 10	March 10
Last known date snows in vicinity[5]	April 24	April 23	April 28	April 23	April 23	April 18	April 27

1. Extreme cold spell at this time.
2. Snow geese migrate further south.
3. Stopped coming to Alaksen.
4. 1,500 snows off Lulu Island Feb. 28/87.
5. Prior to 1980 - Courtesy R. Husband. 1974=April 28; 1975=April 21; 1976=April 22; 1977=April 25; 1978=April 25; 1979=April 19.

Table 2. Chronology of events relating to Canada geese and field-feeding ducks at the Alaksen National Wildlife Area, 1980 to 1987.

Events	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
Counts start	Aug. 7	Sept. 22	Aug. 19	Aug. 10	Aug. 31	Aug. 30	Sept. 5
Canada geese on above date	454+	432+	370	182	341	29	219+
First ducks on Alaksen fields[1]	Aug. 28	Sept. 22	Oct. 14	Oct. 21	Sept. 5	Sept. 16	Sept. 29
Duck hunting seasons opens	Oct. 11	Oct. 10	Oct. 9	Oct. 8	Oct. 6	Oct. 12	Oct. 11
Canada hunting season opens	Oct. 27	Oct. 10	Oct. 9	Oct. 8	Oct. 6	Oct. 12	Oct. 11
Hunting season closes	Note 2	Jan. 24	Jan. 23	Jan. 22	Jan. 20	Jan. 26	Jan. 25
First wigeon field-feeding	Oct. 14	Oct. 22	Oct. 14	Oct. 21	Oct. 12	Oct. 9	Oct. 27[3]
Highest count of Canada geese	1,779+	1,662+	522+	1,154+	907+	970+	790+
Date of count	Oct. 14	Oct. 19	Oct. 18	Nov. 10	Oct. 1	Oct. 11	Nov. 7
General counts finished	March 13	March 22	March 14	March 30	March 29	March 12	March 27

1. Mallards, wigeon and pintail if present.
2. Hunting for Canada geese ended December 1; for ducks January 25.
3. Foggy October 20-26; wigeon may have arrived earlier than observed.

Table 3. Changes in hectares of various crops planted at the Alaksen National Wildlife Area, 1974 to 1986.

Year	Standing barley	Grain stubble	Forage	Fall rye[1]	Fallow	Corn
1974	32	72	28	14	-	4
1975	38	75	20	6	-	4
1976	61	20	27	32	-	4
1977	60	22	34	32	-	4
1978	6	24	44	32	-	8
1979	13	8	42	72	-	nil
1980	12	8	59	55	-	6
1981	6	6	74	34	-	8
1982	8	nil	74	55	-	2
1983	11	nil	67	59	-	2
1984	nil	nil	65	64	16	nil
1985	12[1]	2[2]	53[3]	45	28[4]	1985 nil 1. nurse crop 2. swathed barley 3. 12 hectares newly seeded 4. 20 hectares flooded fields 6
1986	3	6[1]	65[2]	48	10[3]	1986 1. swathed barley 2. 12 hectares flooded fields 3. 8 hectares flooded fields

1. Potatoes are seeded annually on Alaksen for commercial purposes. The yield of discarded culls being available to waterfowl is difficult to determine as those fields are seeded to fall fye following the potatoe harvest. Therefore we are assuming that fall rye is the main food source for waterfowl, with culled potatoes being an added source. Potatoes are mentioned in the text to point out that snow geese do have the ability to grub for them.

Table 4. Dabbling Duck-days of use at the Alaksen National Wildlife Area by year and field, 1980 to 1986.

Year	Field	Mallards	Wigeon	Pintail	Unident.[1] dabbling ducks	Total dabbling ducks
80	1	1500	0	0	0	1500
80	2	31690	0	17	7800	39507
80	3	400	0	3100	2870	6370
80	4	0	3750	0	0	3720
80	5	0	2400	0	0	2400
80	6	100	0	0	4800	4900
80	8	0	360	0	5120	5480
80	9	300	0	0	1450	1750
80	14	9068	14060	0	74122	97250
80	15	450	0	0	10060	10510
81	1	1055	0	0	0	1055
81	2	220	0	0	0	220
81	3	1653	0	0	0	1653
81	4	50	0	0	0	50
81	5	385	1685	0	16805	18875
81	6	1850	0	0	6145	7995
81	8	768	0	0	3315	4083
81	9	0	0	0	0	0
81	14	712	21	0	350	1083
81	15	1600	610	0	48265	50475
82	1	0	0	0	0	0
82	2	0	0	0	0	0
82	3	3250	35	0	4900	8185
82	4	560	7585	0	4332	12477
82	5	105	3325	0	11185	14615
82	6	595	753	0	7560	8908
82	8	2790	0	0	1880	4670
82	9	0	0	0	0	0
82	14	350	10000	0	3000	13350
82	15	150	2700	0	10000	12850
83	1	10855	3500	0	7350	21705
83	2	1075	4500	0	8520	14095
83	3	80	17825	0	5025	22930
83	4	225	341	0	13818	14384
83	5	25	6020	0	15050	21095
83	6	400	4250	0	64750	69400
83	8	500	60	0	2730	3290
83	9	0	0	0	0	0
83	14	250	2100	0	5800	8150
83	15	5300	0	0	36600	41900

Table 4. (cont'd)

Year	Field	Mallards	Wigeon	Pintail	Unident.[1] dabbling ducks	Total dabbling ducks
84	1	758	11730	0	12650	25138
84	2	1050	1800	0	0	2850
84	3	125	0	0	2377	2502
84	4	0	34810	0	5020	39830
84	5	0	50	0	1250	1300
84	6	0	15017	0	23700	38717
84	8	196	2330	0	1435	3961
84	9	20	0	0	0	20
84	14	1093	8200	0	11470	20763
84	15	6547	900	0	11800	19247
85	1	49	0	0	0	49
85	2	0	0	0	0	0
85	3	0	1200	0	80	1280
85	4	370	7912	140	0	8422
85	5	595	7550	35	0	8180
85	6	2055	4175	190	4000	10420
85	8	10569	3821	1788	2559	18738
85	9	38256	8515	4207	3569	54547
85	14	0	200	0	0	200
85	15	6450	5065	0	0	11515
86	1	358	290	2	13	663
86	2	0	0	0	0	0
86	3	752	1293	78	110	2233
86	4	814	18996	133	3796	23739
86	5	3925	0	0	0	3925
86	6	15737	17229	4100	21537	58603
86	8	6912	27315	6463	5384	46074
86	9	12835	5884	2783	6033	27535
86	14	2300	40	5	0	2345
86	15	7180	2830	350	42775	53135
TOTAL		197261	273034	23392	543162	

1. Includes green-winged teal, gadwall, northern shoveler, pintail and mixtures of wigeon and mallards.

Table 5. Dabbling Duck-days of use at the Alaksen National Wildlife Area by year, 1980 to 1986.

Year	Mallards	Wigeon	Pintail	Unident. dabbling ducks	Total dabbling ducks
80	43508	20570	3117	106222	173418
81	8294	2316	0	74880	85490
82	7800	24398	0	42857	75057
83	18710	38596	0	159643	216950
84	9790	74837	0	69702	154331
85	58344	38438	6361	10208	113352
86	50814	73877	13914	79649	218254

Table 6. Monthly dabbling duck-days of individual field use at the Alaksen National Wildlife Area from 1980-1986, by species.

Field	Mo.	Mallards	Wigeon	Pintail	Unident. dabbling ducks	Total duck-days
1	AUG	1200	0	0	0	1200
1	SEP	60	0	0	0	60
1	OCT	720	6900	0	2000	9620
1	NOV	10500	4800	0	0	15300
1	DEC	299	0	0	4900	5199
1	JAN	1005	3530	0	12750	17285
1	FEB	569	290	2	363	1244
1	MAR	223	0	0	0	223
2	AUG	0	0	0	0	0
2	SEP	1050	0	0	0	1050
2	OCT	31690	0	17	7800	39507
2	NOV	0	400	0	0	400
2	DEC	950	1400	0	70	2420
2	JAN	220	4500	0	8450	13170
2	FEB	125	0	0	0	125
2	MAR	0	0	0	0	0
3	AUG	0	0	300	0	300
3	SEP	400	0	2800	0	3200
3	OCT	0	0	0	2400	2400
3	NOV	1500	2350	0	3695	7545
3	DEC	3175	15440	5	4280	22900
3	JAN	477	2015	0	2825	5317
3	FEB	356	363	23	2112	2854
3	MAR	352	184	50	50	636
4	AUG	0	0	0	0	0
4	SEP	0	0	0	0	0
4	OCT	0	14950	0	0	14950
4	NOV	338	24370	5	5050	29763
4	DEC	237	8716	0	350	9303
4	JAN	767	5390	237	8014	14408
4	FEB	432	8853	30	9361	18676
4	MAR	245	11115	0	4191	15551
5	AUG	0	0	0	0	0
5	SEP	0	0	0	0	10875
5	OCT	0	10375	0	500	25660
5	NOV	0	5185	0	20475	15520
5	DEC	4030	1545	0	9945	9670
5	JAN	620	1300	35	7715	6355
5	FEB	385	2625	0	3345	2310
5	MAR	0	0	0	2310	

Table 6. continued

Field	Mo.	Mallards	Wigeon	Pintail	Unident. dabbling ducks	Total duck-days
6	AUG	0	0	0	0	0
6	SEP	0	0	0	0	0
6	OCT	225	1300	50	250	1825
6	NOV	320	9430	105	61595	71458
6	DEC	850	13200	50	6560	20660
6	JAN	2230	1545	60	23010	26845
6	FEB	1712	450	0	18295	20457
6	MAR	15400	15500	4025	22782	57707
8	AUG	0	0	0	0	0
8	SEP	6300	0	750	0	7050
8	OCT	1179	1400	950	1900	5429
8	NOV	684	3775	43	4592	9094
8	DEC	1548	5745	270	1057	8620
8	JAN	9207	12922	4067	4950	31146
8	FEB	2285	5699	1633	7057	16674
8	MAR	532	4345	538	2866	8281
9	AUG	0	0	0	0	0
9	SEP	6100	0	0	0	6100
9	OCT	3735	595	275	1020	5625
9	NOV	1183	260	20	923	2386
9	DEC	3380	250	132	302	4064
9	JAN	31982	10940	5315	4282	52519
9	FEB	3752	1979	1005	2917	9653
9	MAR	1278	375	242	1606	3501
14	AUG	0	0	0	0	0
14	SEP	0	0	0	0	0
14	OCT	548	300	0	20377	21225
14	NOV	435	7960	0	45660	54055
14	DEC	140	12321	0	13100	25561
14	JAN	8547	14040	5	15535	38127
14	FEB	3590	0	0	70	3660
14	MAR	513	0	0	0	513
15	AUG	0	0	0	0	0
15	SEP	450	0	0	0	450
15	OCT	1400	5650	0	13270	20320
15	NOV	12575	4235	0	51525	68335
15	DEC	6412	680	250	21690	29032
15	JAN	3925	0	0	50500	54425
15	FEB	1555	1540	100	14115	17310
15	MAR	1360	0	0	8400	9700

Table 7. Total bird-days of individual field use at the Alaksen National Wildlife Area by species, from 1980 to 1987.

Field	Canada geese	Snow geese	Mallards	Wigeon	Pintail	Unident. dabbling ducks	Total dabbling ducks
1	62550	301707	14576	15520	2	20013	50112
2	27438	214558	34035	6300	17	16320	56673
3	85364	73859	6260	20353	3178	15362	45154
4	33762	179684	2019	73395	273	26966	102654
5	26998	66850	5035	21030	35	44290	70390
6	67390	144780	20737	41425	4290	132493	198945
8	33525	5855	21736	33886	8251	22423	86297
9	10061	0	51411	14399	6990	11052	83853
14	104773	172330	13773	34621	5	94742	143142
15	76730	412755	27677	12105	350	159500	199633

Table 8. Use of fields in the Alaksen National Wildlife Area by waterfowl, 1980-87, expressed as birds per hectare per year. Use of individual fields is shown, and average use of fields 4, 5, and 6 which were used to pasture livestock until late summer, and fields 3 and 15 where hay was consistently cut.

Field	Canada geese	Snow geese	Mallard	Wigeon	Pintail	Unident. dabblers	Total dabblers
1	319	1539	74	79	-	102	256
2	326	2554	405	75	0.2	194	675
3	871	754	64	208	32	157	461
4	603	329	36	1311	5	482	1833
5	321	796	60	250	0.4	527	838
6	507	1089	156	312	32	996	1496
8*	599	105	388	605	147	400	1541
9*	120	-	612	172	83	132	998
14	748	1230	98	247	-	677	1022
15	783	4212	282	124	4	1628	2037
Hay-field	827	2483	173	166	18	892	1249
Pasture	469	1433	102	498	17	746	1363

* - Fields 8 and 9 were flooded in winter, 1985-87, greatly increasing their use by ducks (see Table 9).

Table 9. Fall and winter use by dabbling ducks of fields #8 and #9, on the Alaksen National Wildlife Area, during the period 1980-85 when the fields were not flooded, and during the period 1985-87, when the fields were flooded.

	Number of bird-days				Number of bird-days			
	1980-81 through 1984-85				1985-86 and 1986-87			
Species	Field No. 8	Field No. 9	Total	Average/ month	Field No. 8	Field No. 9	Total	Average/ month
Mallard	4,254	320	4,574	177.3	17,481	51,090	68,571	5,274.7
Wigeon	2,750	0	2,750	70.5	31,136	14,399	45,535	3,502.7
Pintail	0	0	0	0.0	8,251	6,989	15,240	1,172.3
Unident. dabblers	14,480	1,450	15,930	408.5	7,941	9,600	17,541	1,349.3
Totals	21,484	1,770	23,254	596.3	64,809	82,078	146,887	11,299.0

Table 10. The average numbers of dabbling duck days per month, counted on Alaksen from 1980 to 1987.

Month	Mallards	Wigeon	Pintails	Unident.	Total
August	1,200	0	300	0	1,500
September	14,630	0	3,550	0	17,910
October	39,497	41,470	1,292	49,517	131,776
November	27,535	62,765	173	193,515	283,988
December	21,021	59,297	707	62,254	143,279
January	58,980	56,182	9,719	138,031	262,912
February	14,761	21,799	2,793	57,635	96,988
March	19,903	31,519	4,855	42,205	98,482

FIGURES

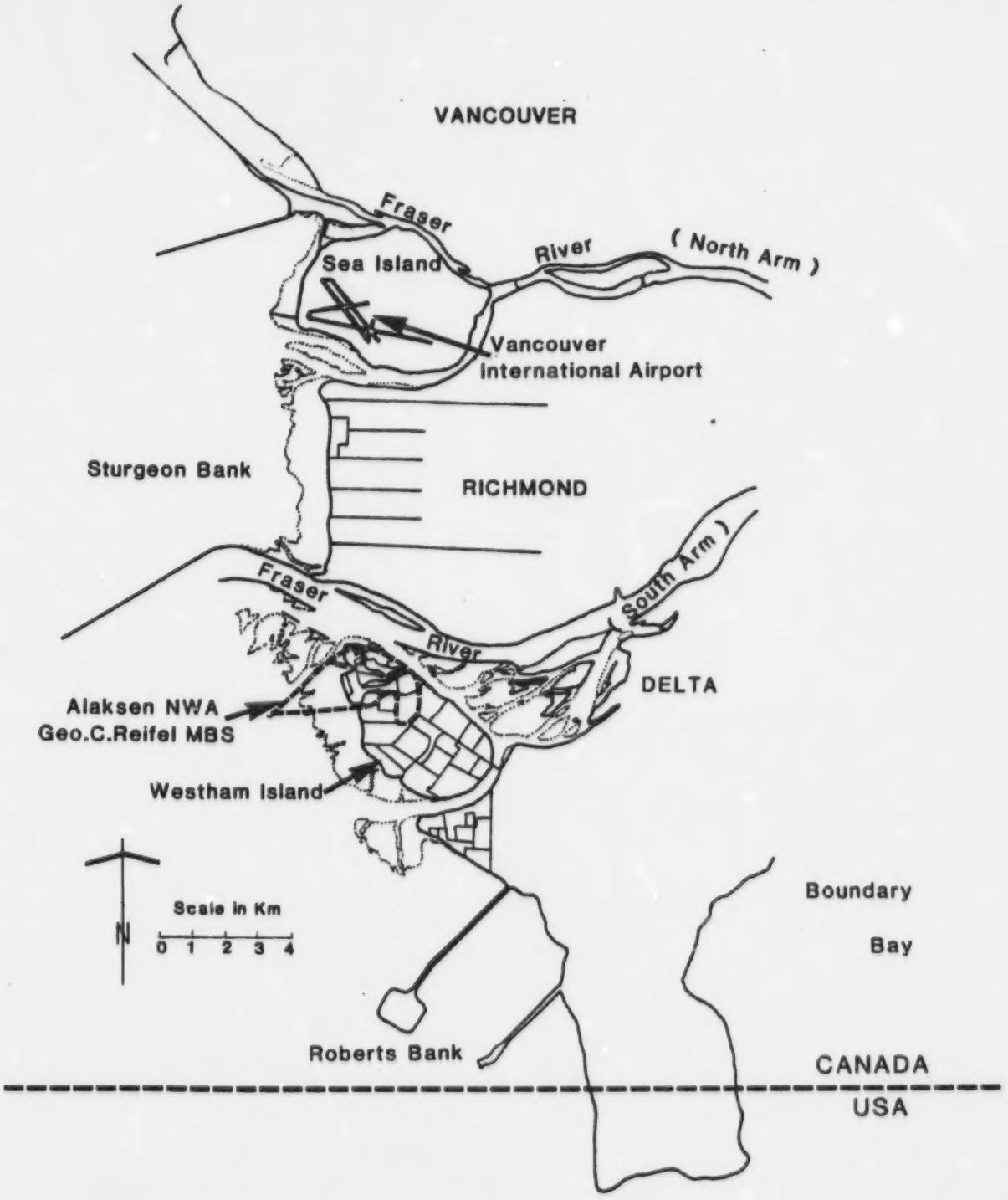


Figure 1. The foreshore of the Fraser River delta from Point Grey to Point Roberts.

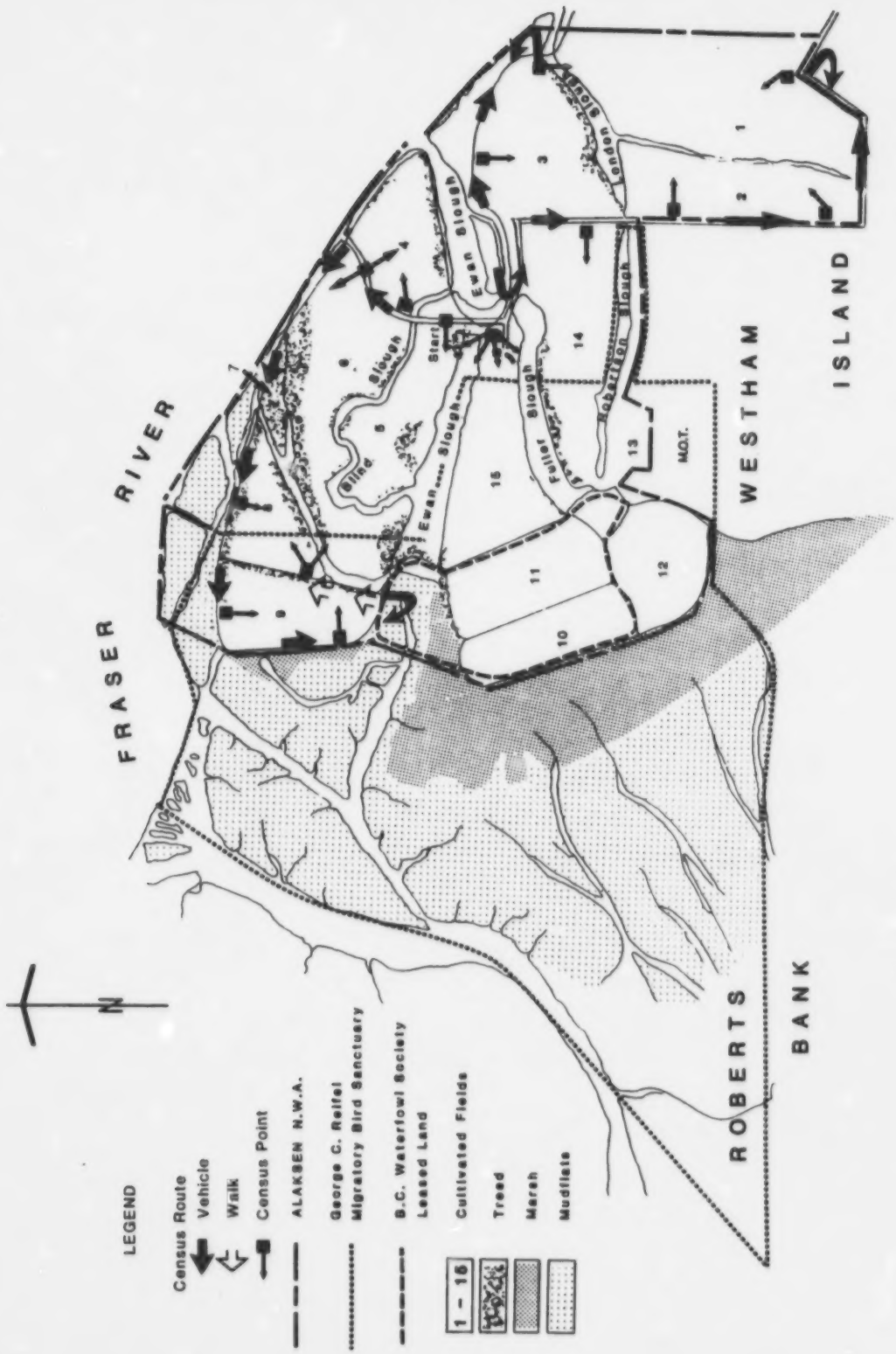


Figure 2. The Alaksen National Wildlife Area and George C. Reifel Migratory Bird Sanctuary.

Figure 3

USE BY GEESE OF FIELDS 1 TO 15: 1980 - 1981

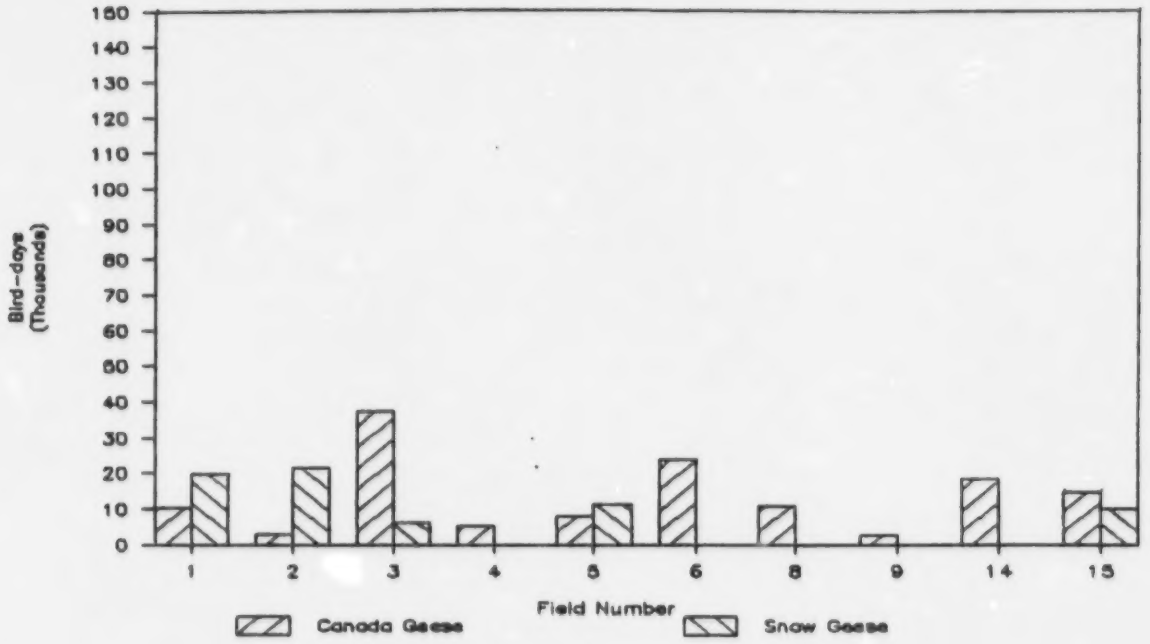


Figure 4

USE BY GEESE OF FIELDS 1 TO 15: 1981 - 1982

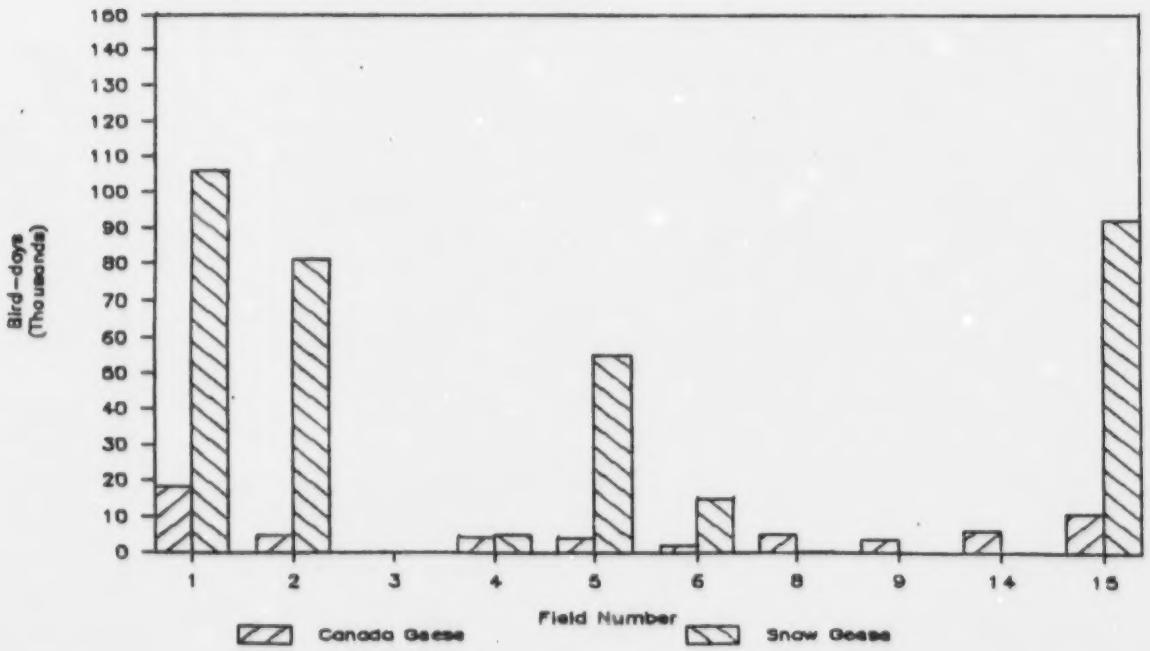


Figure 5

USE BY GEESE OF FIELDS 1 TO 15: 1982 - 1983

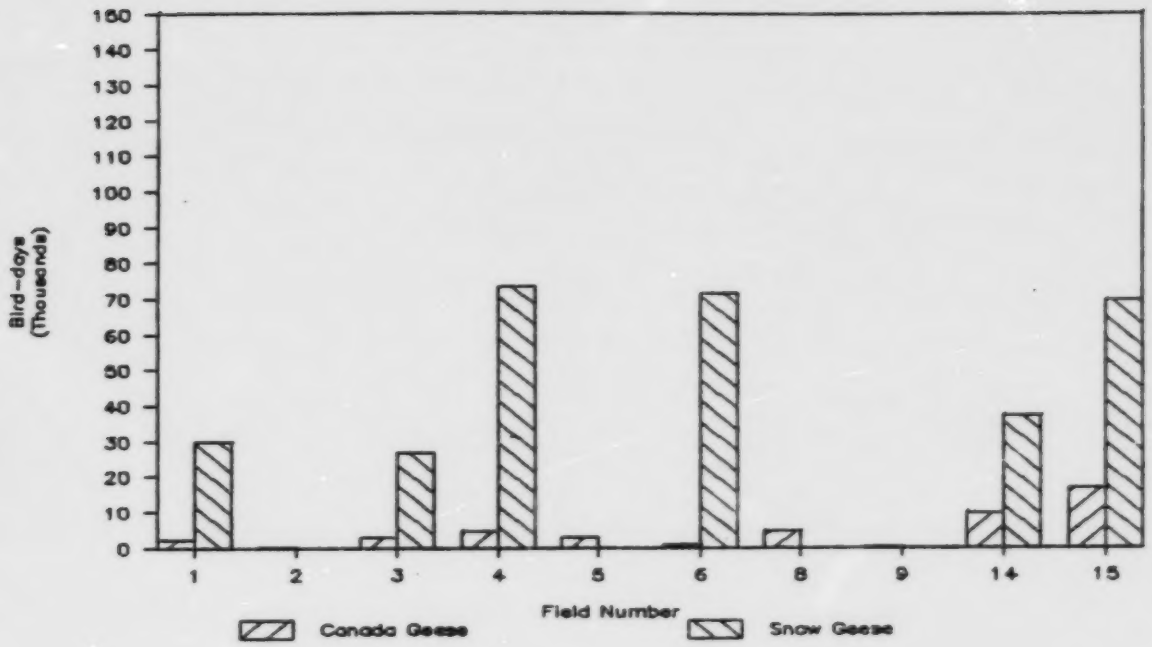


Figure 6

USE BY GEESE OF FIELDS 1 TO 15: 1983 - 1984

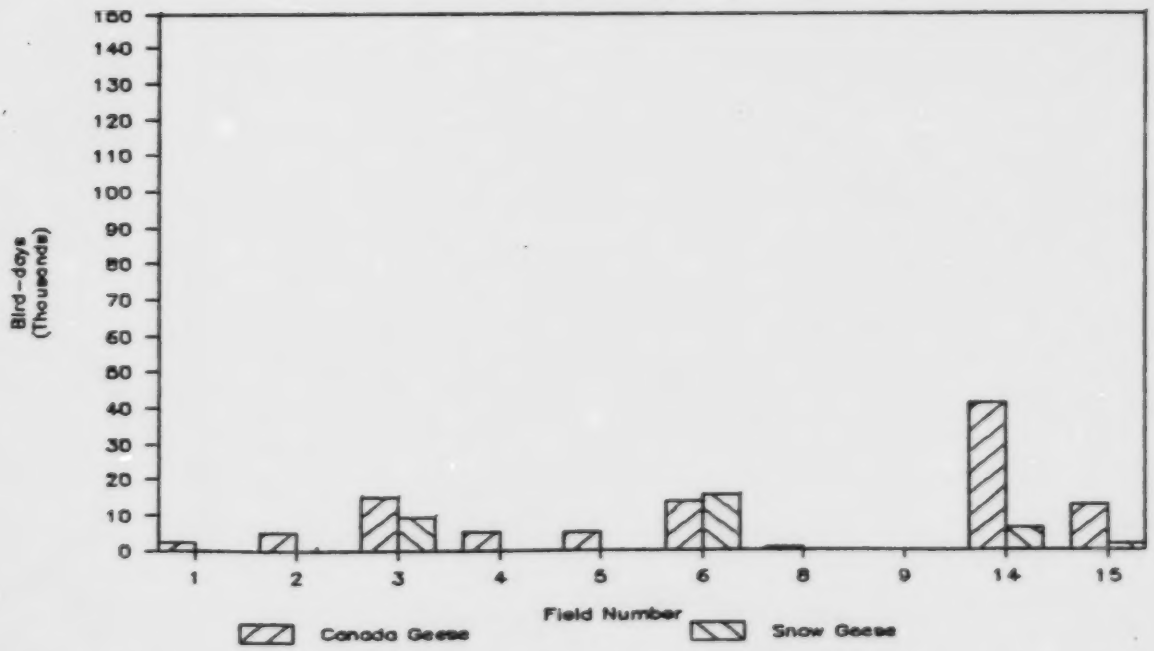


Figure 7

USE BY GEESE OF FIELDS 1 TO 15: 1984 - 1985

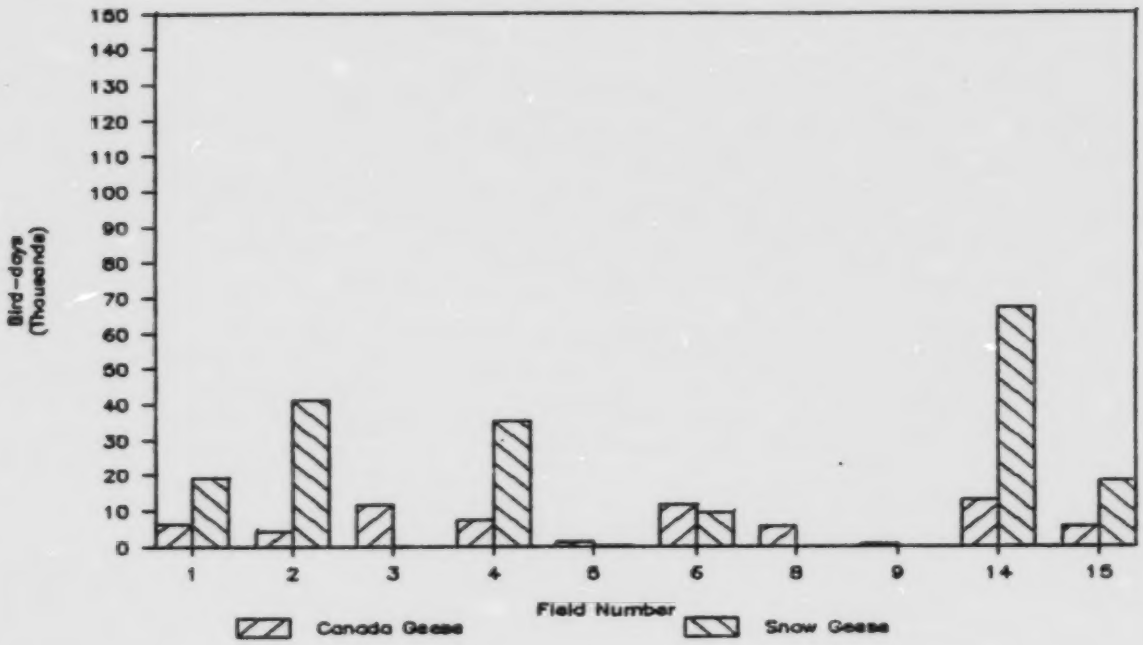


Figure 8

USE BY GEESE OF FIELDS 1 TO 15: 1985 - 1986

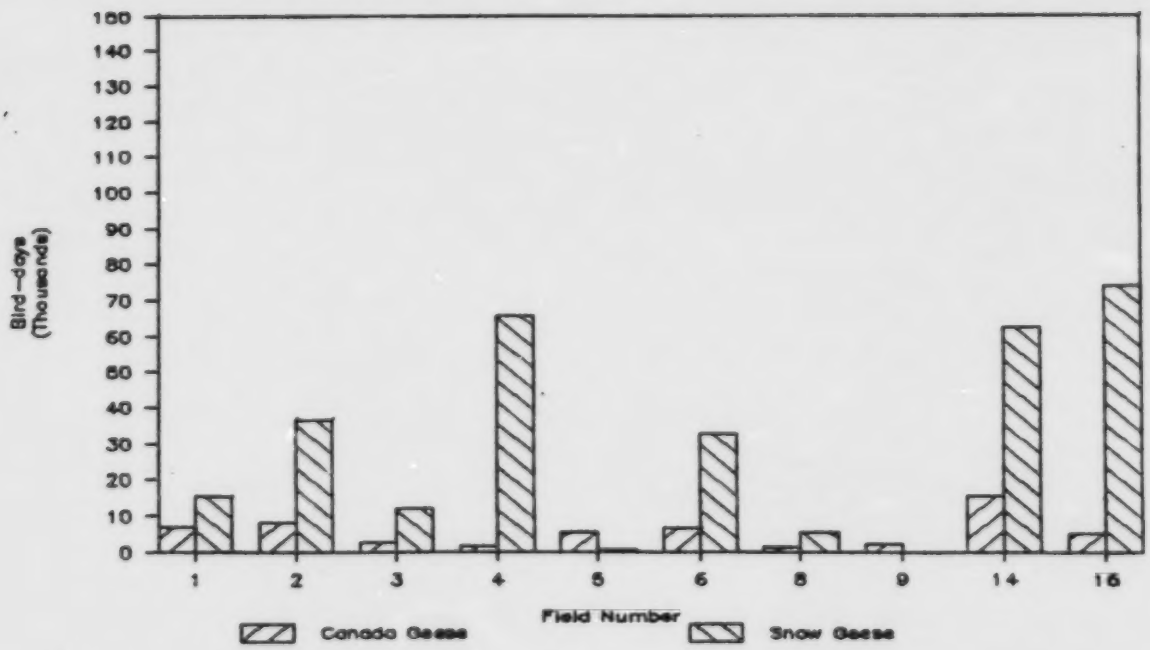


Figure 9

USE BY GEESE OF FIELDS 1 TO 15: 1986 - 1987

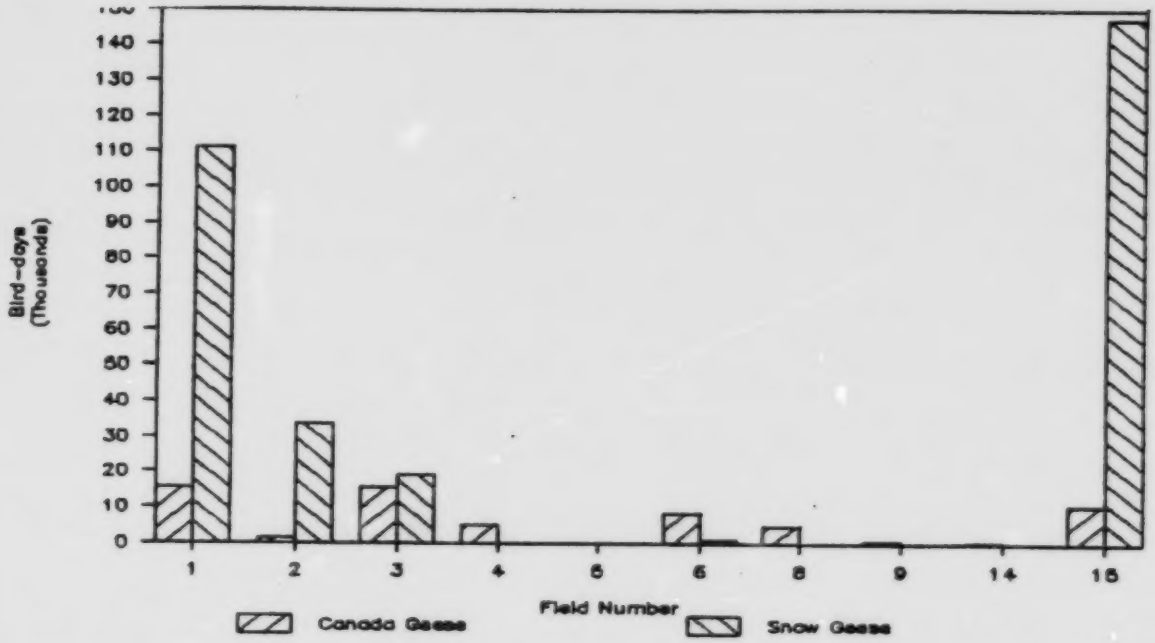


Figure 10

ANNUAL AVERAGE USE BY GEESE OF FIELDS 1 TO 15: 1980 - 1986

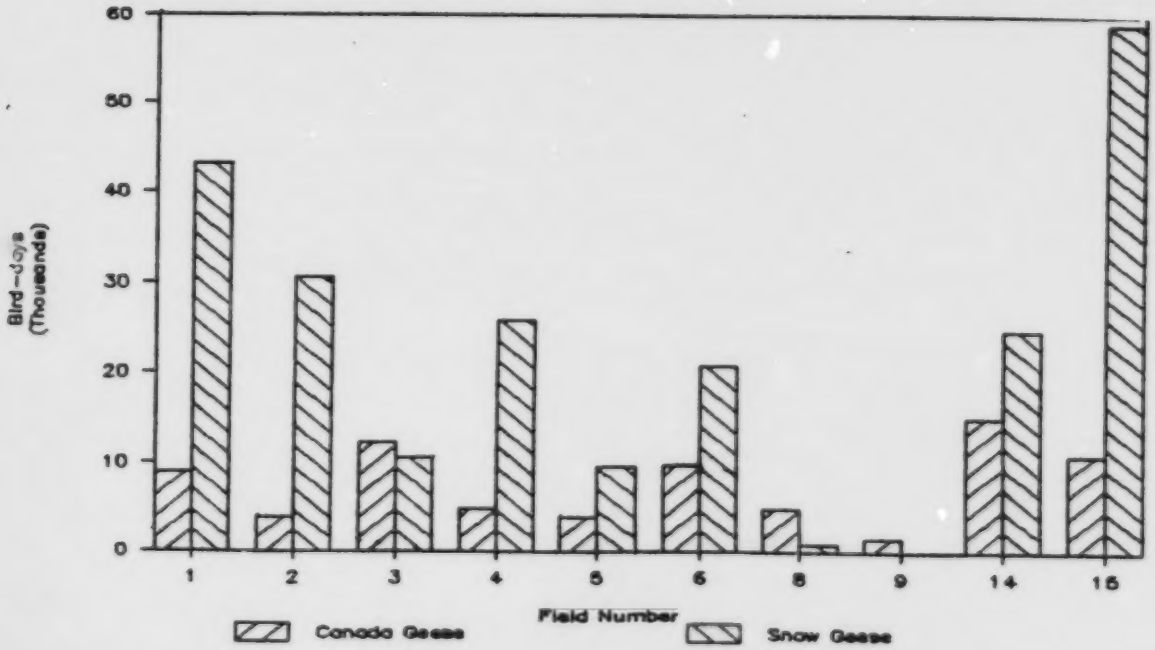


Figure 11

ANNUAL USE OF ALL FIELDS COMBINED BY GEESE: 1980 - 1987

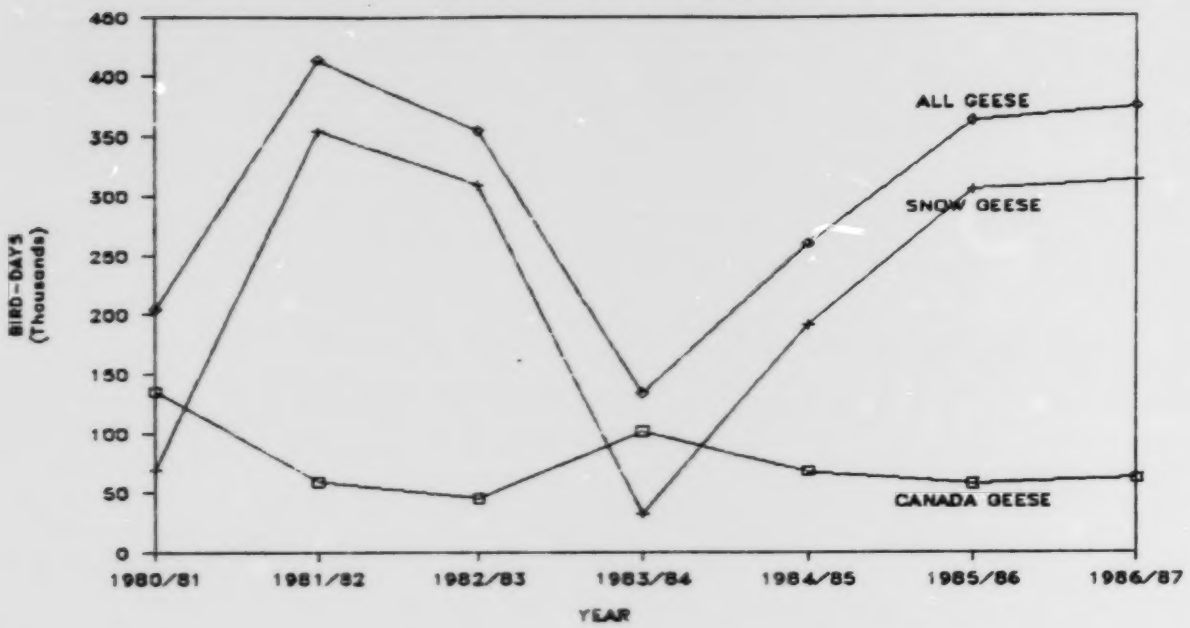


Figure 12

ANNUAL AVERAGE USE OF FIELD 1 BY GEESE PER MONTH: 1980 - 1986

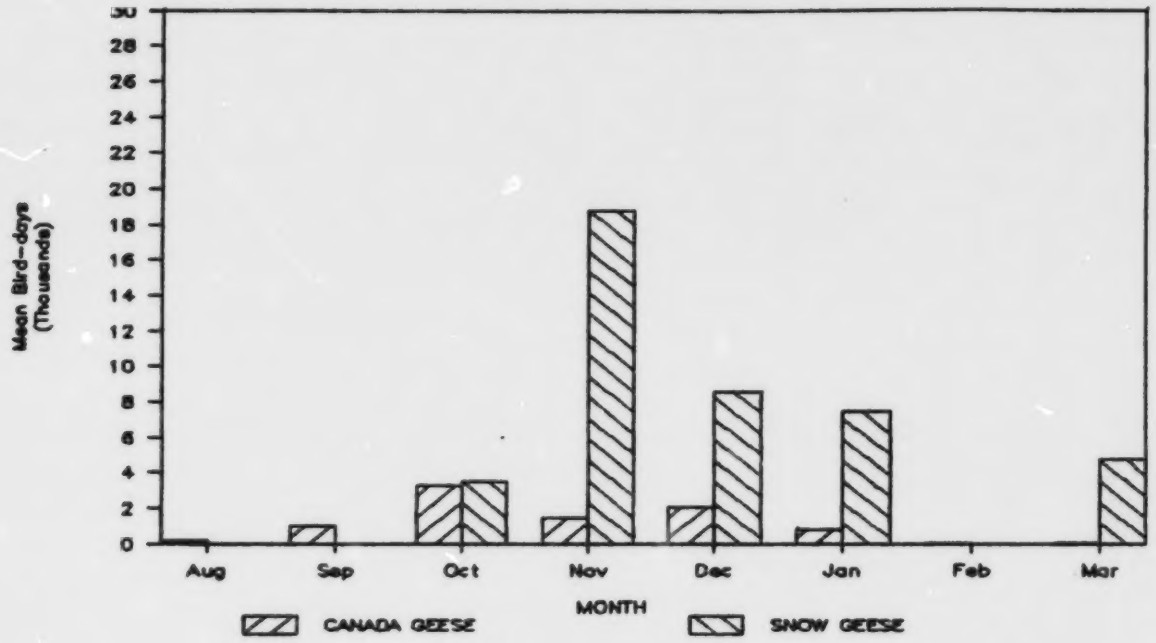


Figure 13

ANNUAL AVERAGE USE OF FIELD 2 BY GEESE PER MONTH: 1980 - 1986

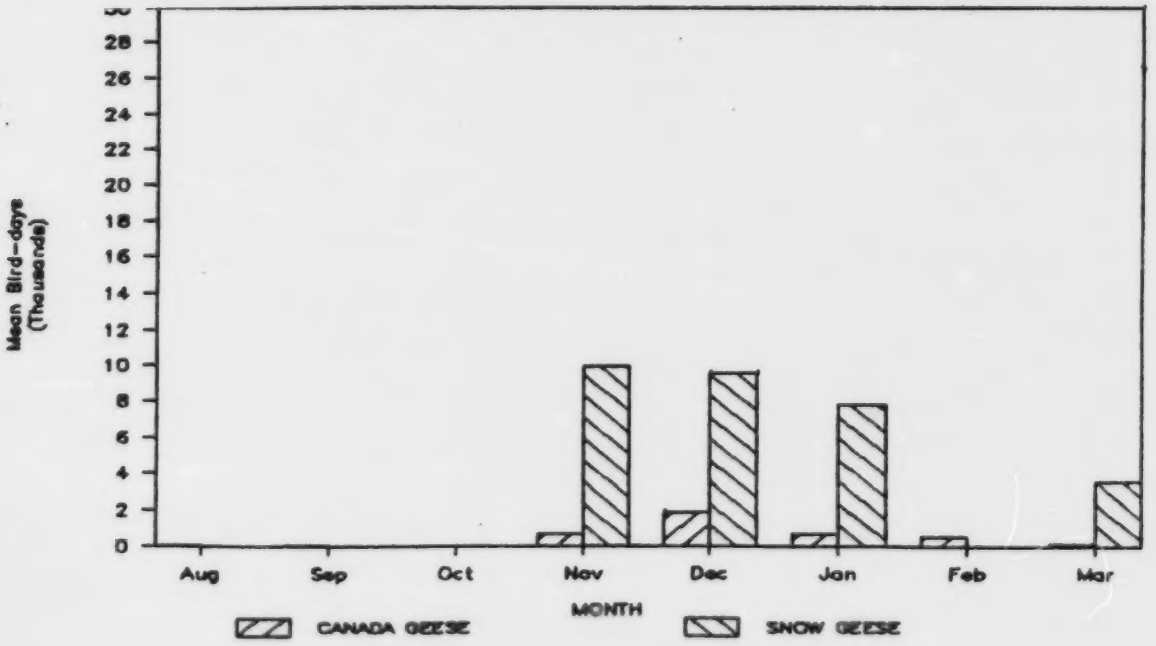


Figure 14

ANNUAL AVERAGE USE OF FIELD 3 BY GEESE PER MONTH: 1980 - 1986

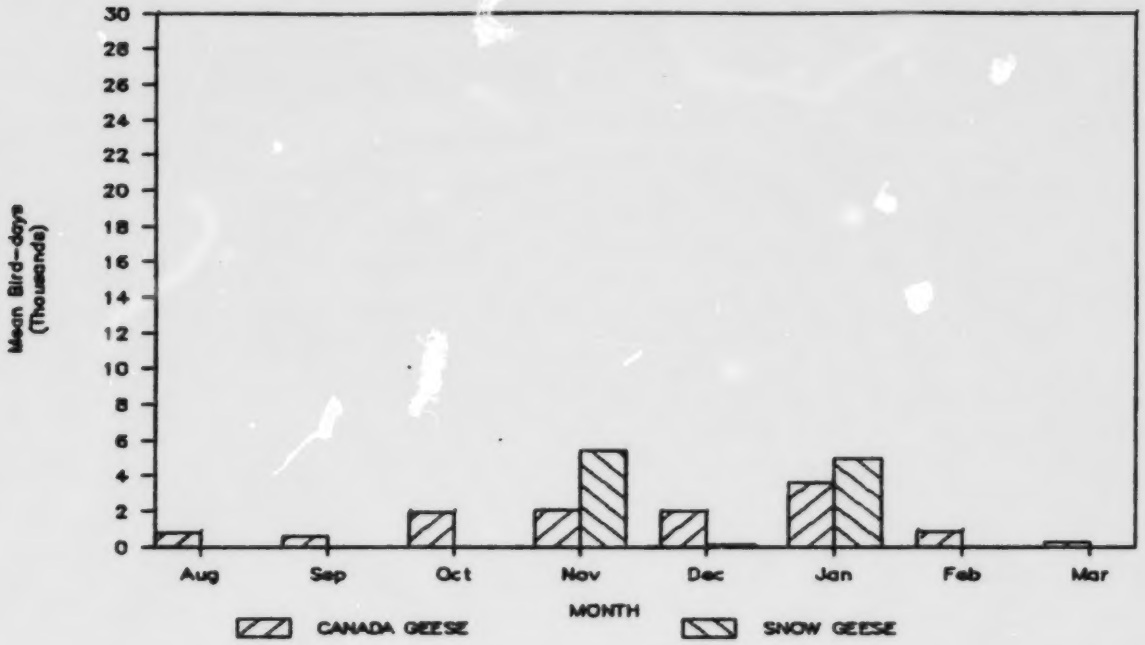


Figure 15

ANNUAL AVERAGE USE OF FIELD 4 BY GEESE PER MONTH: 1980 - 1986

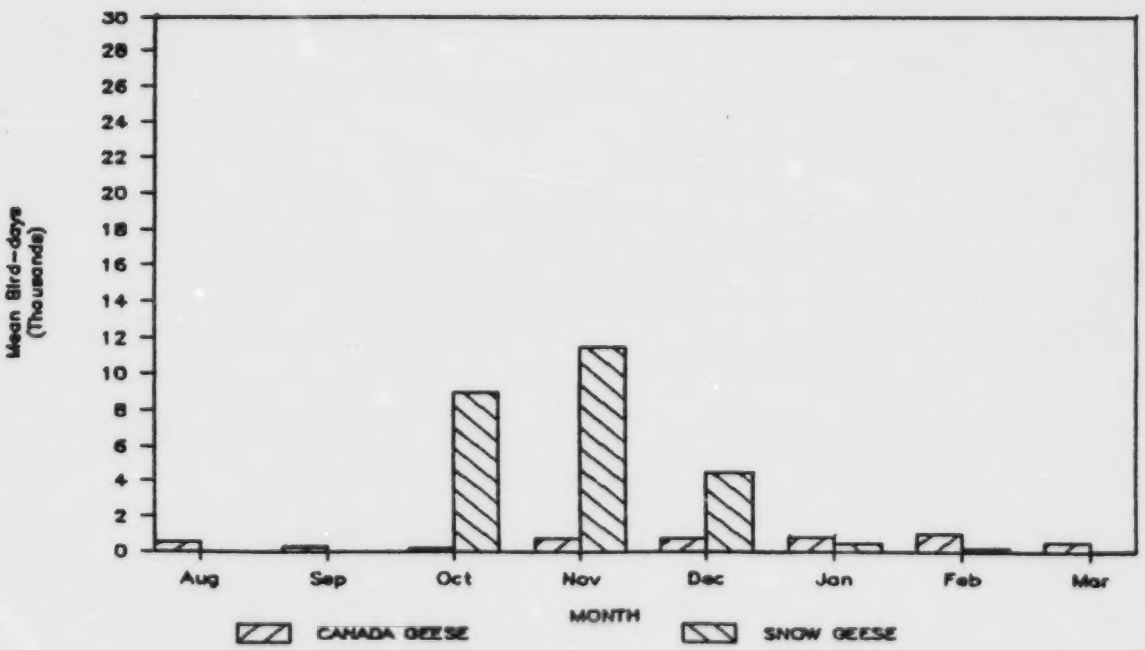


Figure 16

ANNUAL AVERAGE USE OF FIELD 5 BY GEESE PER MONTH: 1980 - 1986

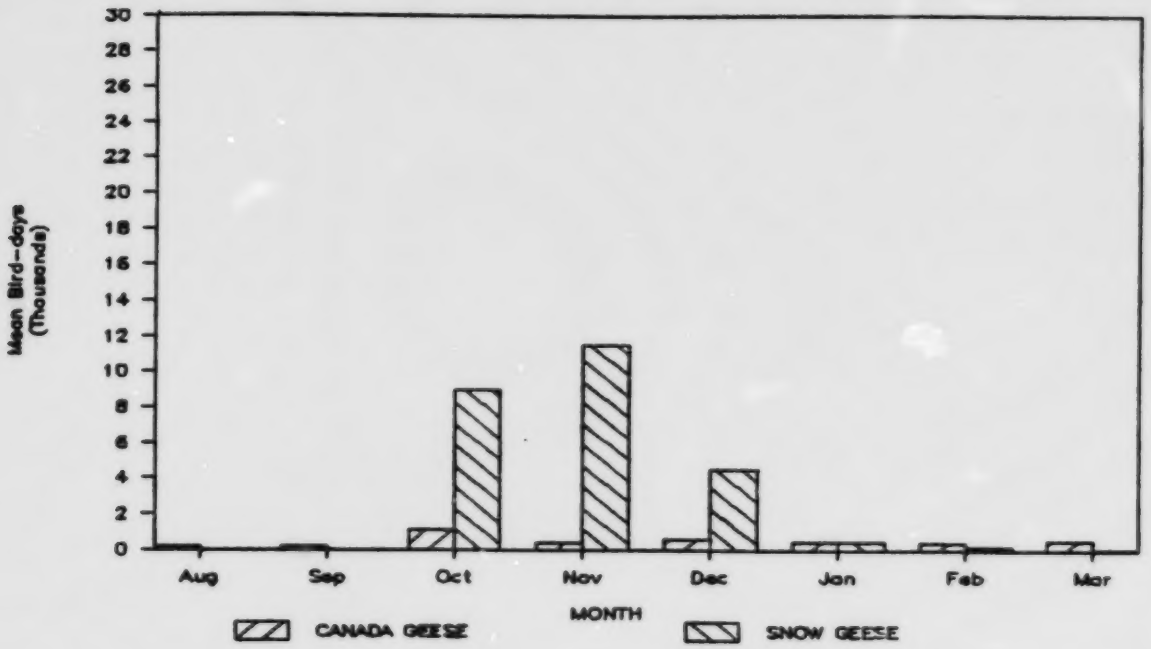


Figure 17

ANNUAL AVERAGE USE OF FIELD 6 BY GEESE PER MONTH: 1980 - 1986

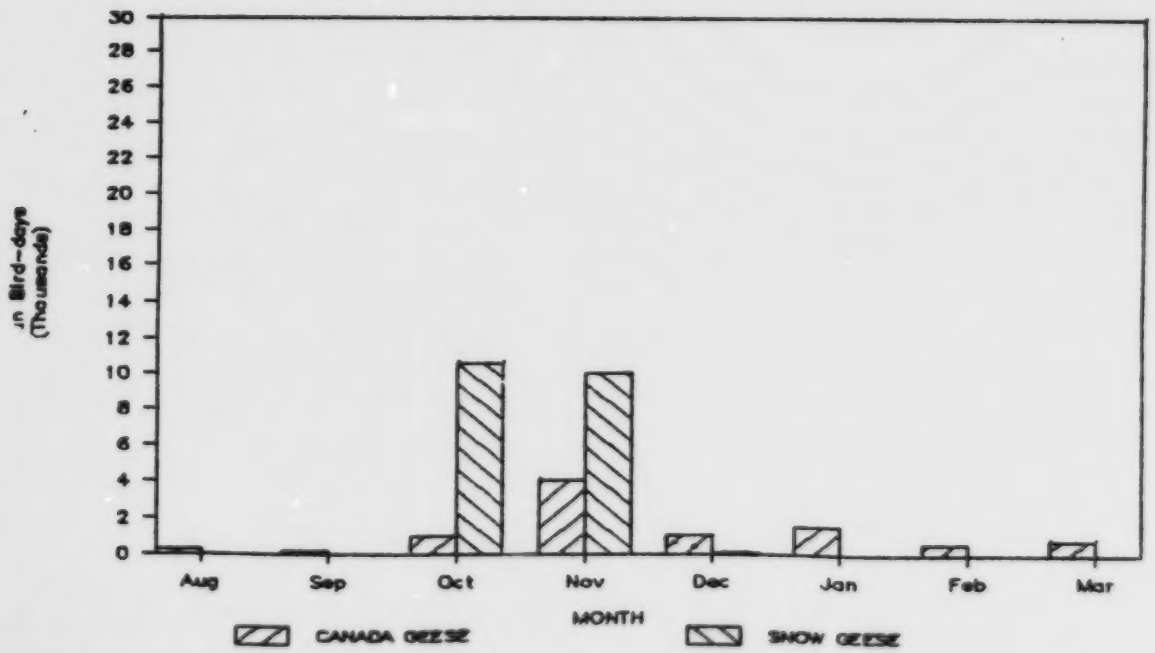


Figure 18

ANNUAL AVERAGE USE OF FIELD 8 BY GEESE PER MONTH: 1980 - 1986

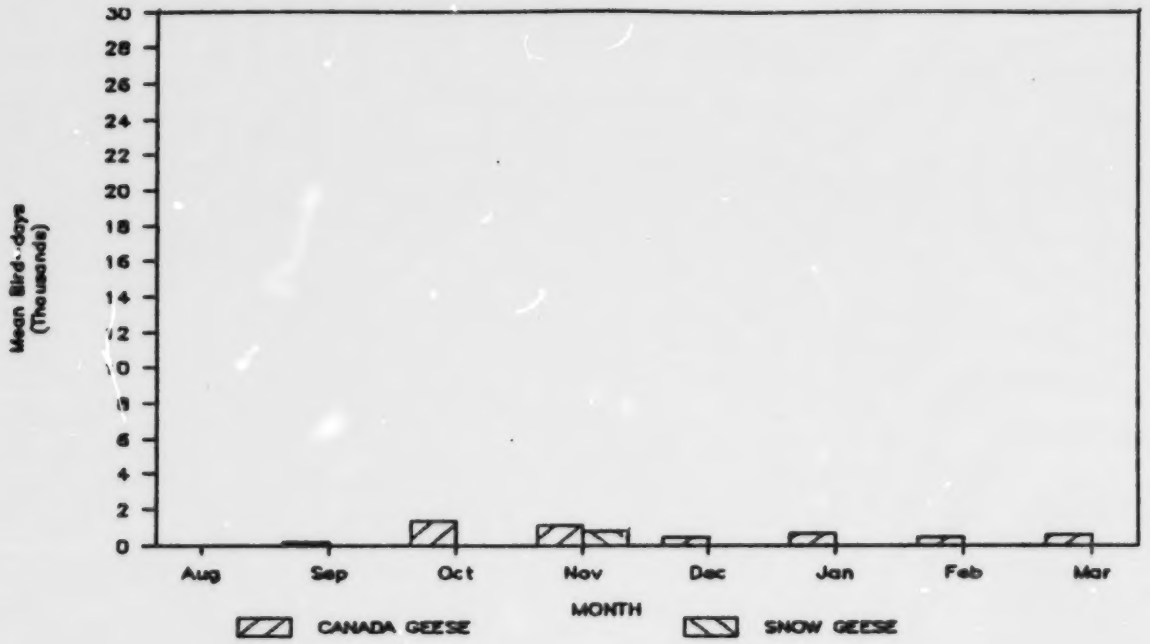


Figure 19

ANNUAL AVERAGE USE OF FIELD 9 BY GEESE PER MONTH: 1980 - 1986

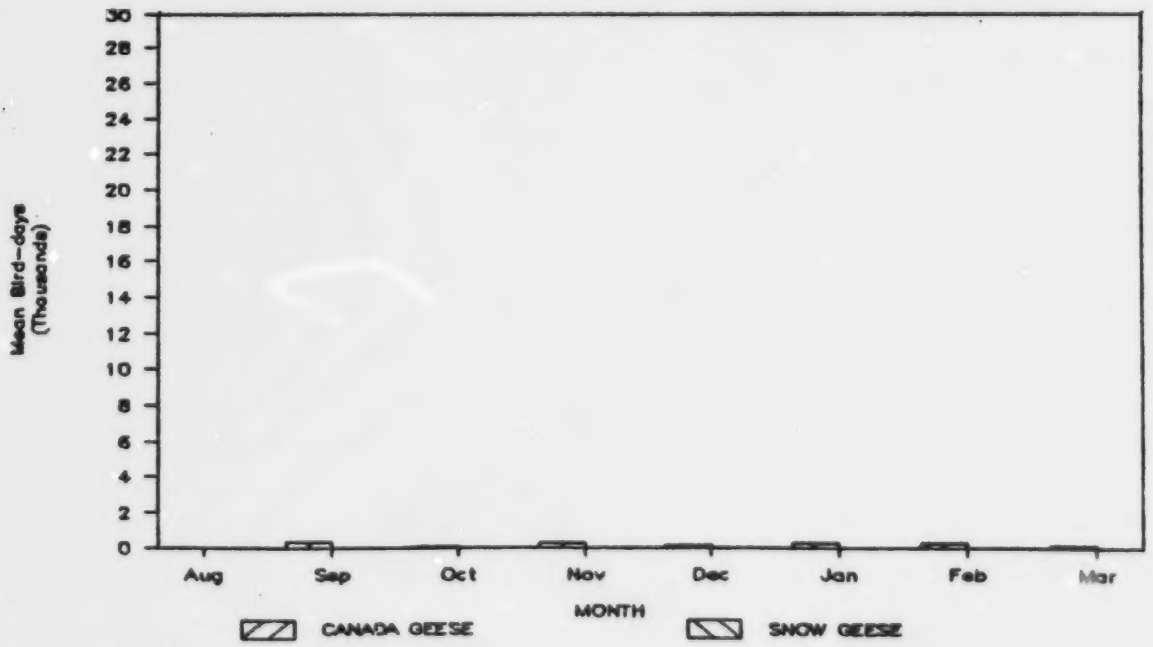


Figure 20

ANNUAL AVERAGE USE OF FIELD 14 BY GEESE PER MONTH: 1980 - 1986

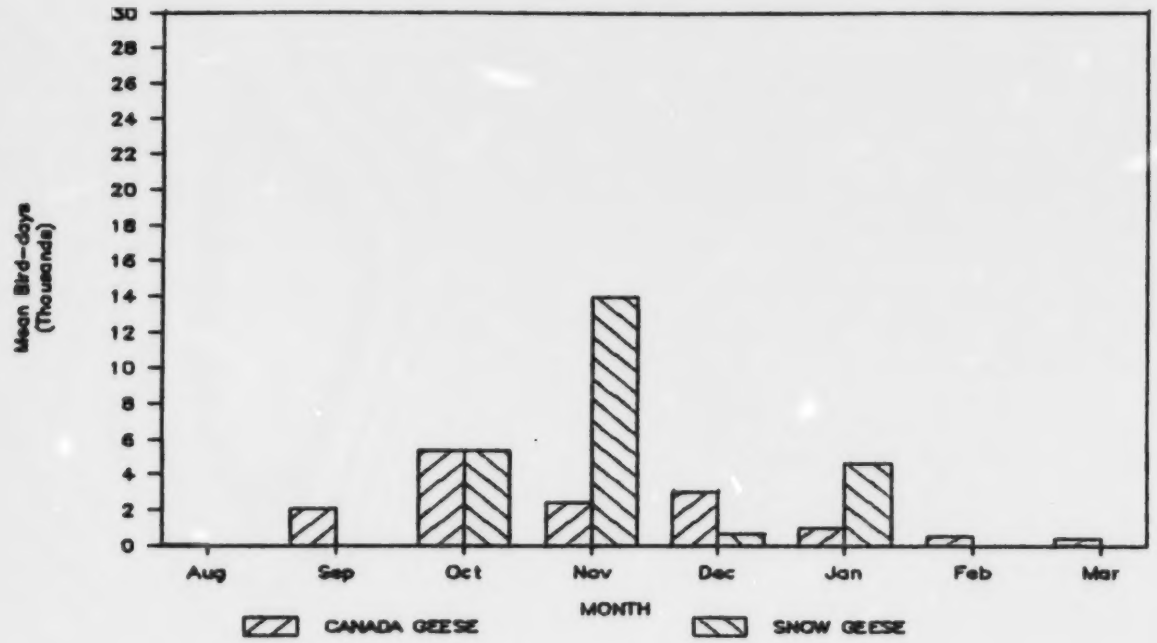
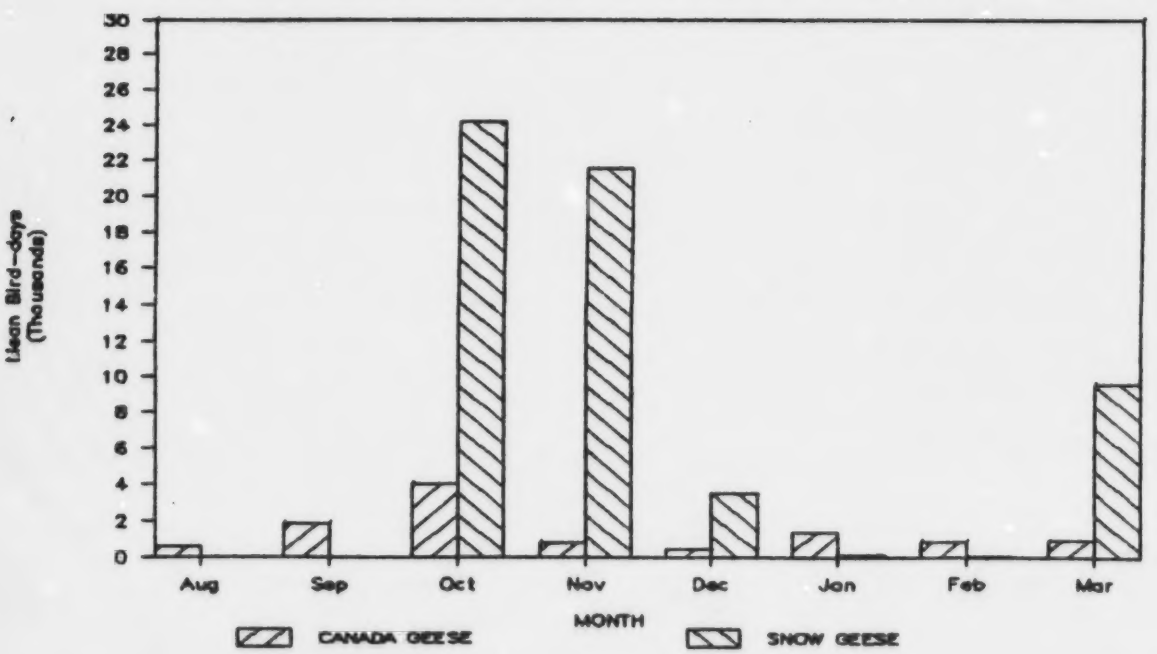


Figure 21

ANNUAL AVERAGE USE OF FIELD 15 BY GEESE PER MONTH: 1980 - 1986



APPENDICES

Appendix 1. Waterfowl species observed on the Alaksen National Wildlife Area.

Common Name	Status	Common Name	Status
Tundra Swan	fcW	Canvasback	cW
Trumpeter Swan	fcW	Redhead	raW
Greater White-fronted Goose	uF,W	Ring-necked Duck	raW
Lesser Snow Goose	aF,W,Sp	Tufted Duck	caW
Emperor Goose	caW	Greater Scaup	cW
Brant	raSp	Lesser Scaup	uW
Canada Goose	aR	Oldsquaw	uW
Wood Duck	fcR	Black Scoter	raW
Green-winged Teal	aW,uS	Surf Scoter	uW
Mallard	aW,cS	White-winged Scoter	raW
Northern Pintail	aW,raS	Common Goldeneye	rcW
Blue-winged Teal	fcS	Bufflehead	cW
Cinnamon Teal	fcS	Smew	caW
Northern Shoveller	fcW,uS	Hooded Merganser	fcW
Gadwall	fcR	Common Merganser	fcW
Eurasian Wigeon	fcW	Red-breasted Merganser	cw
American Wigeon	aW,uS	Ruddy Duck	fcW

Abbreviations

Sp = spring (March-May)
S = summer (June-August)
F = fall (late August-November)
W = winter (December-February)
R = resident; present year round

a = abundant; generally 100+ seen on each day
c = common; generally 26-100 seen on each day
fc = fairly common; generally 5-25 seen on each day
u = uncommon; fewer than 5 seen on each day, often missed
ra = rare; seen fewer than 10 times per year
ca = casual; seen fewer than once per year and often outside its normal range

Footnote: The black duck, an introduced species, has bred at Alaksen. The harlequin duck and barrow's goldeneye, both common in winter locally, have not been observed on Alaksen. No blue colour phases of the Lesser Snow Goose were observed during this study.

Appendix 2. Bird-days of individual fields at the Alaksen National Wildlife Area from 1980 to 1987, by month and species.

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
80	1	AUG	1500	120[1]	1200	0	0	0
80	1	SEP	2859	120[1]	0	0	0	0
80	1	OCT	0	0	0	0	0	0
80	1	NOV	1140	0	0	0	0	0
80	1	DEC	420	0	0	0	0	0
81	1	JAN	4235	19750	300	0	0	0
81	1	FEB	162	0	0	0	0	0
81	1	MAR	54	0	0	0	0	0
80	2	AUG	0	0	0	0	0	0
80	2	SEP	0	0	0	0	0	0
80	2	OCT	35	0	31690	0	17	7800
80	2	NOV	282	5	0	0	0	0
80	2	DEC	2000	1510	0	0	0	0
81	2	JAN	20	20000	0	0	0	0
81	2	FEB	770	0	0	0	0	0
81	2	MAR	18	0	0	0	0	0
80	3	AUG	4861	0	0	0	300	0
80	3	SEP	2951	0	400	0	2800	0
80	3	OCT	8590	0	0	0	0	1400
80	3	NOV	7224	5402	0	0	0	1470
80	3	DEC	5180	1050	0	0	0	0
81	3	JAN	3200	0	0	0	0	0
81	3	FEB	4186	0	0	0	0	0
81	3	MAR	1044	0	0	0	0	0
80	4	AUG	524	0	0	0	0	0
80	4	SEP	1330	0	0	0	0	0
80	4	OCT	840	0	0	0	0	0
80	4	NOV	0	0	0	3750	0	0
80	4	DEC	0	0	0	0	0	0
81	4	JAN	0	0	0	0	0	0
81	4	FEB	2364	0	0	0	0	0
81	4	MAR	324	0	0	0	0	0
80	5	AUG	986	0	0	0	0	0
80	5	SEP	601	0	0	0	0	0
80	5	OCT	924	0	0	0	0	0
80	5	NOV	688	77	0	0	0	0
80	5	DEC	1840	11200	0	0	0	0

1. Refuge snow geese.

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
81	5	JAN	830	0	0	0	0	0
81	5	FEB	930	0	0	2400	0	0
81	5	MAR	1368	0	0	0	0	0
80	6	AUG	182	0	0	0	0	0
80	6	SEP	1272	0	0	0	0	0
80	6	OCT	1564	0	0	0	0	0
80	6	NOV	15775	0	100	0	0	2750
80	6	DEC	3080	0	0	0	0	0
81	6	JAN	120	0	0	0	0	0
81	6	FEB	828	0	0	0	0	2050
81	6	MAR	918	0	0	0	0	0
80	8	AUG	70	0	0	0	0	0
80	8	SEP	288	0	0	0	0	0
80	8	OCT	3859	0	0	0	0	1400
80	8	NOV	2071	0	0	0	0	2720
80	8	DEC	1610	0	0	0	0	0
81	8	JAN	1380	0	0	0	0	1000
81	8	FEB	611	0	0	0	0	0
81	8	MAR	1215	0	0	360	0	0
80	9	AUG	0	0	0	0	0	0
80	9	SEP	150	0	0	0	0	0
80	9	OCT	378	0	0	0	0	0
80	9	NOV	55	0	0	0	0	0
80	9	DEC	280	0	0	0	0	0
81	9	JAN	826	0	300	0	0	1000
81	9	FEB	569	0	0	0	0	0
81	9	MAR	414	0	0	0	0	450
80	14	AUG	0	0	0	0	0	0
80	14	SEP	1009	0	0	0	0	0
80	14	OCT	14740	0	48	0	0	16877
80	14	NOV	2022	0	0	60	0	36060
80	14	DEC	70	0	0	0	0	10750
81	14	JAN	280	0	6000	14000	0	10435
81	14	FEB	116	0	2930	0	0	0
81	14	MAR	243	0	90	0	0	0
80	15	AUG	1294	0	0	0	0	0
80	15	SEP	2454	90	450	0	0	0
80	15	OCT	3210	234	0	0	0	4920
80	15	NOV	682	1073	0	0	0	2000
80	15	DEC	587	4000	0	0	0	0
80	15	JAN	3195	717	0	0	0	3000
80	15	FEB	1330	336	0	0	0	140
80	15	MAR	1926	3600	0	0	0	0

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
81	1	SEP	1819	0	60	0	0	0
81	1	OCT	12980	0	0	0	0	0
81	1	NOV	3450	89000	0	0	0	0
81	1	DEC	105	12600	0	0	0	0
82	1	JAN	0	0	680	0	0	0
82	1	FEB	84	0	315	0	0	0
82	1	MAR	100	4125	0	0	0	0
81	2	SEP	0	0	0	0	0	0
81	2	OCT	0	0	0	0	0	0
81	2	NOV	962	24600	0	0	0	0
81	2	DEC	1738	56700	0	0	0	0
82	2	JAN	1143	0	220	0	0	0
82	2	FEB	325	0	0	0	0	0
82	2	MAR	432	0	0	0	0	0
81	3	SEP	0	0	0	0	0	0
81	3	OCT	0	0	0	0	0	0
81	3	NOV	0	0	0	0	0	0
81	3	DEC	0	0	1500	0	0	0
82	3	JAN	0	0	153	0	0	0
82	3	FEB	0	0	0	0	0	0
82	3	MAR	61	0	0	0	0	0
81	4	SEP	0	0	0	0	0	0
81	4	OCT	0	0	0	0	0	0
81	4	NOV	0	0	0	0	0	0
81	4	DEC	0	0	0	0	0	0
82	4	JAN	444	3357	0	0	0	0
82	4	FEB	3123	1543	0	0	0	0
82	4	MAR	623	252	50	0	0	0
81	5	SEP	65	0	0	0	0	0
81	5	OCT	2230	0	0	0	0	0
81	5	NOV	277	54671	0	1685	0	3325
81	5	DEC	194	56	0	0	0	8645
82	5	JAN	206	0	0	0	0	4275
82	5	FEB	33	0	385	0	0	350
82	5	MAR	830	0	0	0	0	210
81	6	SEP	0	0	0	0	0	0
81	6	OCT	0	0	0	0	0	0
81	6	NOV	840	15075	70	0	0	720
81	6	DEC	892	17	30	0	0	770
82	6	JAN	60	0	0	0	0	1750
82	6	FEB	14	0	1400	0	0	2310
82	6	MAR	40	0	350	0	0	595

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
81	8	SEP	8	0	0	0	0	0
81	8	OCT	1050	0	0	0	0	0
81	8	NOV	1298	140	400	0	0	0
81	8	DEC	783	91	18	0	0	0
82	8	JAN	431	0	0	0	0	700
82	8	FEB	518	0	350	0	0	2100
82	8	MAR	1061	0	0	0	0	515
81	9	SEP	0	0	0	0	0	0
81	9	OCT	20	0	0	0	0	0
81	9	NOV	1678	0	0	0	0	0
81	9	DEC	547	0	0	0	0	0
82	9	JAN	733	0	0	0	0	0
82	9	FEB	347	0	0	0	0	0
82	9	MAR	241	0	0	0	0	0
81	14	SEP	5840	0	0	0	0	0
81	14	OCT	0	0	0	0	0	0
81	14	NOV	162	0	60	0	0	0
81	14	DEC	146	0	0	21	0	350
82	14	JAN	0	0	137	0	0	0
82	14	FEB	0	0	305	0	0	0
82	14	MAR	299	0	210	0	0	0
81	15	SEP	612	0	0	0	0	0
81	15	OCT	6850	5750	0	350	0	0
81	15	NOV	2336	66900	550	260	0	12400
81	15	DEC	987	18557	0	0	0	11490
82	15	JAN	54	0	0	0	0	11250
82	15	FEB	0	0	0	0	0	13125
82	15	MAR	176	1100	1050	0	0	0
82	1	AUG	0	0	0	0	0	0
82	1	SEP	0	0	0	0	0	0
82	1	OCT	0	0	0	0	0	0
82	1	NOV	0	0	0	0	0	0
82	1	DEC	2170	28000	0	0	0	0
83	1	JAN	0	0	0	0	0	0
83	1	FEB	0	0	0	0	0	0
83	1	MAR	0	2100	0	0	0	0
82	2	AUG	0	0	0	0	0	0
82	2	SEP	4	0	0	0	0	0
82	2	OCT	0	0	0	0	0	0
82	2	NOV	0	0	0	0	0	0
82	2	DEC	0	0	0	0	0	0
83	2	JAN	0	0	0	0	0	0
83	2	FEB	367	0	0	0	0	0
83	2	MAR	0	0	0	0	0	0

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
82	3	AUG	0	0	0	0	0	0
82	3	SEP	0	0	0	0	0	0
82	3	OCT	0	0	0	0	0	0
82	3	NOV	0	0	1400	0	0	0
82	3	DEC	0	0	1400	0	0	4200
83	3	JAN	3052	27000	275	35	0	700
83	3	FEB	0	0	175	0	0	0
83	3	MAR	0	0	0	0	0	0
82	4	AUG	1961	0	0	0	0	0
82	4	SEP	3	0	0	0	0	0
82	4	OCT	0	0	0	0	0	0
82	4	NOV	448	42000	308	6350	0	0
82	4	DEC	0	31500	140	0	0	350
83	4	JAN	1855	0	7	35	0	1007
83	4	FEB	228	0	105	1200	0	2060
83	4	MAR	38	0	0	0	0	915
82	5	AUG	21	0	0	0	0	0
82	5	SEP	49	0	0	0	0	0
82	5	OCT	874	3	0	3025	0	0
82	5	NOV	418	9	0	300	0	6200
82	5	DEC	156	0	105	0	0	1300
83	5	JAN	153	0	0	0	0	1340
83	5	FEB	758	0	0	0	0	245
83	5	MAR	426	0	0	0	0	2100
82	6	AUG	0	0	0	0	0	0
82	6	SEP	0	0	0	0	0	0
82	6	OCT	297	57800	0	750	0	0
82	6	NOV	156	13500	0	0	0	2375
82	6	DEC	0	0	595	0	0	140
83	6	JAN	28	0	0	3	0	10
83	6	FEB	247	0	0	0	0	1435
83	6	MAR	269	0	0	0	0	3600
82	8	AUG	0	0	0	0	0	0
82	8	SEP	0	0	0	0	0	0
82	8	OCT	528	0	0	0	0	300
82	8	NOV	1089	0	40	0	0	0
82	8	DEC	448	0	450	0	0	0
83	8	JAN	1084	0	1950	0	0	880
83	8	FEB	1199	0	350	0	0	0
83	8	MAR	420	0	0	0	0	700

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
82	9	AUG	0	0	0	0	0	0
82	9	SEP	0	0	0	0	0	0
82	9	OCT	0	0	0	0	0	0
82	9	NOV	220	0	0	0	0	0
82	9	DEC	0	0	0	0	0	0
83	9	JAN	0	0	0	0	0	0
83	9	FEB	83	0	0	0	0	0
83	9	MAR	14	0	0	0	0	0
82	14	AUG	0	0	0	0	0	0
82	14	SEP	1027	0	0	0	0	0
82	14	OCT	0	0	0	0	0	0
82	14	NOV	1404	0	0	0	0	0
82	14	DEC	5976	4500	70	10000	0	0
83	14	JAN	737	32500	0	0	0	3000
83	14	FEB	469	0	105	0	0	0
83	14	MAR	35	0	175	0	0	0
82	15	AUG	1703	0	0	0	0	0
82	15	SEP	3682	0	0	0	0	0
82	15	OCT	8174	2537	0	1100	0	700
82	15	NOV	770	55000	0	1000	0	5600
82	15	DEC	189	0	0	600	0	0
83	15	JAN	162	0	0	0	0	2450
83	15	FEB	1633	0	0	0	0	350
83	15	MAR	340	11850	150	0	0	900
83	1	AUG	0	0	0	0	0	0
83	1	SEP	0	0	0	0	0	0
83	1	OCT	0	0	0	0	0	0
83	1	NOV	596	0	10500	0	0	0
83	1	DEC	1587	0	250	0	0	3350
84	1	JAN	221	0	0	3500	0	4000
84	1	FEB	47	0	0	0	0	0
84	1	MAR	12	0	105	0	0	0
83	2	AUG	0	0	0	0	0	0
83	2	SEP	0	0	0	0	0	0
83	2	OCT	0	0	0	0	0	0
83	2	NOV	0	0	0	0	0	0
83	2	DEC	283	0	950	0	0	70
84	2	JAN	2414	0	0	4500	0	8450
84	2	FEB	2239	0	125	0	0	0
84	2	MAR	59	0	0	0	0	0

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
83	3	AUG	627	0	0	0	0	0
83	3	SEP	316	0	0	0	0	0
83	3	OCT	0	0	0	0	0	0
83	3	NOV	3844	9306	0	450	0	900
83	3	DEC	2036	0	0	15425	0	0
84	3	JAN	6800	0	0	1600	0	2125
84	3	FEB	1335	0	81	350	0	2000
84	3	MAR	84	0	0	0	0	0
83	4	AUG	1411	0	0	0	0	0
83	4	SEP	11	0	0	0	0	0
83	4	OCT	0	0	0	0	0	0
83	4	NOV	2170	0	25	0	0	2825
83	4	DEC	713	0	0	50	0	0
84	4	JAN	176	0	0	0	0	6650
84	4	FEB	14	0	200	100	0	4250
84	4	MAR	969	0	0	191	0	93
83	5	AUG	176	0	0	0	0	0
83	5	SEP	374	0	0	0	0	0
83	5	OCT	1223	0	0	2750	0	500
83	5	NOV	314	16	0	1250	0	9700
83	5	DEC	684	0	0	1545	0	0
84	5	JAN	290	0	25	250	0	2100
84	5	FEB	745	0	0	225	0	2750
84	5	MAR	1112	0	0	0	0	0
83	6	AUG	959	0	0	0	0	0
83	6	SEP	0	0	0	0	0	0
83	6	OCT	85	0	0	0	0	0
83	6	NOV	7290	15500	0	4000	0	33700
83	6	DEC	550	0	0	0	0	0
84	6	JAN	2777	0	250	0	0	17500
84	6	FEB	538	0	100	0	0	12500
84	6	MAR	1445	0	50	250	0	1050
83	8	AUG	0	0	0	0	0	0
83	8	SEP	0	0	0	0	0	0
83	8	OCT	0	0	0	0	0	0
83	8	NOV	0	0	0	0	0	0
83	8	DEC	0	0	0	0	0	0
84	8	JAN	117	0	375	0	0	0
84	8	FEB	327	0	125	60	0	2500
84	8	MAR	287	0	0	0	0	230

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
83	9	AUG	0	0	0	0	0	0
83	9	SEP	0	0	0	0	0	0
83	9	OCT	0	0	0	0	0	0
83	9	NOV	0	0	0	0	0	0
83	9	DEC	0	0	0	0	0	0
84	9	JAN	0	0	0	0	0	0
84	9	FEB	4	0	0	0	0	0
84	9	MAR	47	0	0	0	0	0
83	14	AUG	401	0	0	0	0	0
83	14	SEP	4057	0	0	0	0	0
83	14	OCT	15400	0	0	0	0	0
83	14	NOV	7432	6200	0	0	0	5800
83	14	DEC	7010	0	0	2100	0	0
84	14	JAN	2227	0	0	0	0	0
84	14	FEB	2684	0	250	0	0	0
84	14	MAR	1745	0	0	0	0	0
83	15	AUG	1033	0	0	0	0	0
83	15	SEP	4190	0	0	0	0	0
83	15	OCT	3095	0	0	0	0	4200
83	15	NOV	60	1500	1350	0	0	25700
83	15	DEC	552	0	1200	0	0	4450
84	15	JAN	1254	0	2750	0	0	1750
84	15	FEB	1402	0	0	0	0	500
84	15	MAR	1031	0	0	0	0	0
84	1	AUG	0	0	0	0	0	0
84	1	SEP	0	0	0	0	0	0
84	1	OCT	1750	13050	720	6900	0	2000
84	1	NOV	1960	4125	0	4800	0	0
84	1	DEC	2534	2160	0	0	0	1550
85	1	JAN	222	0	25	30	0	8750
85	1	FEB	0	0	0	0	0	350
85	1	MAR	61	0	13	0	0	0
84	2	AUG	295	0	0	0	0	0
84	2	SEP	140	0	1050	0	0	0
84	2	OCT	0	90	0	0	0	0
84	2	NOV	75	35300	0	400	0	0
84	2	DEC	3044	5799	0	1400	0	0
85	2	JAN	616	4	0	0	0	0
85	2	FEB	42	0	0	0	0	0
85	2	MAR	250	0	0	0	0	0

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
84	3	AUG	0	0	0	0	0	0
84	3	SEP	550	0	0	0	0	0
84	3	OCT	5118	0	0	0	0	1000
84	3	NOV	1646	21	100	0	0	1325
84	3	DEC	140	0	25	0	0	0
85	3	JAN	4266	0	0	0	0	0
85	3	FEB	4	0	0	0	0	52
85	3	MAR	51	0	0	0	0	0
84	4	AUG	0	0	0	0	0	0
84	4	SEP	350	0	0	0	0	0
84	4	OCT	84	35500	0	10725	0	0
84	4	NOV	653	0	0	10220	0	2210
84	4	DEC	2522	0	0	7170	0	0
85	4	JAN	1826	0	0	520	0	200
85	4	FEB	257	0	0	2500	0	2610
85	4	MAR	1693	0	0	3675	0	0
84	5	AUG	15	0	0	0	0	0
84	5	SEP	122	0	0	0	0	0
84	5	OCT	206	100	0	0	0	0
84	5	NOV	296	73	0	50	0	1250
84	5	DEC	263	99	0	0	0	0
85	5	JAN	125	0	0	0	0	0
85	5	FEB	213	0	0	0	0	0
85	5	MAR	142	0	0	0	0	0
84	6	AUG	785	0	0	0	0	0
84	6	SEP	24	0	0	0	0	0
84	6	OCT	2765	8950	0	550	0	0
84	6	NOV	2414	50	0	1605	0	21700
84	6	DEC	2280	339	0	12850	0	2000
85	6	JAN	1074	0	0	12	0	0
85	6	FEB	695	0	0	0	0	0
85	6	MAR	1857	0	0	0	0	0
84	8	AUG	0	0	0	0	0	0
84	8	SEP	991	0	0	0	0	0
84	8	OCT	1792	0	0	0	0	0
84	8	NOV	738	0	80	130	0	675
84	8	DEC	12	0	0	0	0	0
85	8	JAN	880	0	87	0	0	450
85	8	FEB	333	0	0	0	0	210
85	8	MAR	893	0	29	2200	0	100

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
84	9	AUG	0	0	0	0	0	0
84	9	SEP	0	0	0	0	0	0
84	9	OCT	0	0	0	0	0	0
84	9	NOV	0	0	0	0	0	0
84	9	DEC	0	0	0	0	0	0
85	9	JAN	0	0	0	0	0	0
85	9	FEB	186	0	0	0	0	0
85	9	MAR	279	0	20	0	0	0
84	14	AUG	0	0	0	0	0	0
84	14	SEP	2395	0	0	0	0	0
84	14	OCT	4003	20473	500	300	0	3500
84	14	NOV	943	46450	375	7900	0	3800
84	14	DEC	3430	0	70	0	0	2000
85	14	JAN	1452	0	110	0	0	2100
85	14	FEB	209	0	0	0	0	70
85	14	MAR	571	0	38	0	0	0
84	15	AUG	84	0	0	0	0	0
84	15	SEP	1128	0	0	0	0	0
84	15	OCT	2065	6031	1000	900	0	2500
84	15	NOV	454	10597	5275	0	0	5600
84	15	DEC	87	1912	62	0	0	1250
85	15	JAN	185	0	0	0	0	2450
85	15	FEB	284	0	210	0	0	0
85	15	MAR	1294	0	0	0	0	0
85	1	SEP	40	0	0	0	0	0
85	1	OCT	4930	11200	0	0	0	0
85	1	NOV	1324	3500	0	0	0	0
85	1	DEC	340	0	49	0	0	0
86	1	JAN	299	600	0	0	0	0
86	1	FEB	0	0	0	0	0	0
85	2	SEP	160	0	0	0	0	0
85	2	OCT	0	0	0	0	0	0
85	2	NOV	2100	0	0	0	0	0
85	2	DEC	5934	2450	0	0	0	0
86	2	JAN	300	34400	0	0	0	0
86	2	FEB	0	0	0	0	0	0
85	3	SEP	0	0	0	0	0	0
85	3	OCT	0	0	0	0	0	0
85	3	NOV	496	12000	0	1200	0	0
85	3	DEC	838	0	0	0	0	80
86	3	JAN	1389	0	0	0	0	0
86	3	FEB	0	0	0	0	0	0

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
85	4	SEP	0	0	0	0	0	0
85	4	OCT	293	27250	0	4225	0	0
85	4	NOV	105	38250	0	3600	0	0
85	4	DEC	722	0	0	0	0	0
86	4	JAN	679	0	370	87	140	0
86	4	FEB	0	0	0	0	0	0
85	5	SEP	267	0	0	0	0	0
85	5	OCT	2274	5	0	4600	0	0
85	5	NOV	788	538	0	1900	0	0
85	5	DEC	989	0	0	0	0	0
86	5	JAN	1467	0	595	1050	35	0
86	5	FEB	35	0	0	0	0	0
85	6	SEP	18	0	0	0	0	0
85	6	OCT	1535	7500	225	0	50	250
85	6	NOV	1005	25000	150	3825	105	0
85	6	DEC	427	0	0	0	0	0
86	6	JAN	3595	3	1680	350	35	3750
86	6	FEB	192	0	0	0	0	0
85	8	SEP	11	0	6300	0	750	0
85	8	OCT	0	0	4	250	0	200
85	8	NOV	970	5600	10	180	3	850
85	8	DEC	169	0	395	70	103	242
86	8	JAN	210	0	3790	3307	932	461
86	8	FEB	88	0	70	14	0	805
85	9	SEP	2110	0	6100	0	0	0
85	9	OCT	170	0	3735	595	275	1020
85	9	NOV	0	0	1183	260	20	923
85	9	DEC	22	0	2255	250	132	302
86	9	JAN	29	0	24650	7200	3500	1225
86	9	FEB	49	0	332	210	280	98
85	14	SEP	364	0	0	0	0	0
85	14	OCT	3352	17200	0	0	0	0
85	14	NOV	4855	45000	0	0	0	0
85	14	DEC	4578	7	0	200	0	0
86	14	JAN	2365	0	0	0	0	0
86	14	FEB	441	0	0	0	0	0
85	15	SEP	130	0	0	0	0	0
85	15	OCT	251	8000	0	3300	0	0
85	15	NOV	331	15875	5400	1625	0	0
85	15	DEC	582	0	0	0	0	0
86	15	JAN	3559	0	1050	0	0	0
86	15	FEB	595	0	0	140	0	0
86	15	MAR	0	50000	0	0	0	0

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
86	1	SEP	2319	0	0	0	0	0
86	1	OCT	3536	0	0	0	0	0
86	1	NOV	1741	35150	0	0	0	0
86	1	DEC	7394	17250	0	0	0	0
87	1	JAN	450	31807	0	0	0	0
87	1	FEB	10	0	254	290	2	13
87	1	MAR	94	27050	104	0	0	0
86	2	SEP	0	0	0	0	0	0
86	2	OCT	0	0	0	0	0	0
86	2	NOV	1290	9200	0	0	0	0
86	2	DEC	52	0	0	0	0	0
87	2	JAN	0	0	0	0	0	0
87	2	FEB	0	0	0	0	0	0
87	2	MAR	44	24500	0	0	0	0
86	3	SEP	521	0	0	0	0	0
86	3	OCT	0	0	0	0	0	0
86	3	NOV	1125	11400	0	700	0	0
86	3	DEC	6123	0	250	15	5	0
87	3	JAN	6823	7680	49	380	0	0
87	3	FEB	405	0	101	13	23	60
87	3	MAR	472	0	352	184	50	50
86	4	SEP	0	0	0	0	0	0
86	4	OCT	0	0	0	0	0	0
86	4	NOV	1770	31	5	450	5	15
86	4	DEC	1289	0	97	1496	0	0
87	4	JAN	608	0	390	4748	97	157
87	4	FEB	1195	0	127	5053	30	441
87	4	MAR	231	0	195	7248	0	3183
86	5	SEP	0	0	0	0	0	0
86	5	OCT	0	0	0	0	0	0
86	5	NOV	0	0	0	0	0	0
86	5	DEC	0	0	3925	0	0	0
87	5	JAN	0	0	0	0	0	0
87	5	FEB	0	0	0	0	0	0
87	5	MAR	13	0	0	0	0	0
86	6	SEP	127	0	0	0	0	0
86	6	OCT	930	0	0	0	0	0
86	6	NOV	1174	1045	0	0	0	350
86	6	DEC	77	0	225	350	50	3650
87	6	JAN	3272	0	300	1179	25	0
87	6	FEB	1698	0	212	450	0	0
87	6	MAR	1212	0	15000	15250	4025	17537

Appendix 2. (cont'd)

YEAR	FIELD	MO	CANADA GEESE	SNOW GEESE	MALLARDS	WIGEON	PINTAIL	UNIDENT. DABBLING DUCKS
86	8	SEP	0	0	0	0	0	0
86	8	OCT	2033	0	1175	1150	950	0
86	8	NOV	1800	24	154	3465	40	347
86	8	DEC	0	0	685	5675	167	814
87	8	JAN	558	0	3005	9615	3135	1459
87	8	FEB	46	0	1390	5625	1633	1442
87	8	MAR	241	0	503	1785	538	1321
86	9	SEP	0	0	0	0	0	0
86	9	OCT	0	0	0	0	0	0
86	9	NOV	0	0	0	0	0	0
86	9	DEC	0	0	1125	0	0	0
87	9	JAN	107	0	7032	3740	1815	2057
87	9	FEB	375	0	3420	1769	725	2819
87	9	MAR	125	0	1258	375	242	1156
86	14	SEP	0	0	0	0	0	0
86	14	OCT	0	0	0	0	0	0
86	14	NOV	250	0	0	0	0	0
86	14	DEC	0	0	0	0	0	0
87	14	JAN	2	0	2300	40	5	0
87	14	FEB	0	0	0	0	0	0
87	14	MAR	26	0	0	0	0	0
86	15	SEP	924	2	0	0	0	0
86	15	OCT	4585	147000	400	0	0	950
86	15	NOV	1000	54	0	1350	0	225
86	15	DEC	176	37	5150	80	250	4500
87	15	JAN	1626	0	125	0	0	29600
87	15	FEB	792	0	1345	1400	100	0
87	15	MAR	1628	0	160	0	0	7500
TOTAL			528594	1572380	197261	273034	23392	543162

Appendix 3. Information from field notes gives activites of Snow Geese as quoted:

"Oct. 10, 1974 - 5,000+ snows arrive on foreshore."

"Oct. 20 and 21, 1975 - Migrating snows arriving into Sanctuary both days, 2,000+."

"Oct. 13, 1976 - First migration of snows onto foreshore this date." No numbers given.

"Nov. 17, 1976 - Large migration of snows into Sanctuary today, 10,000 to 15,000."

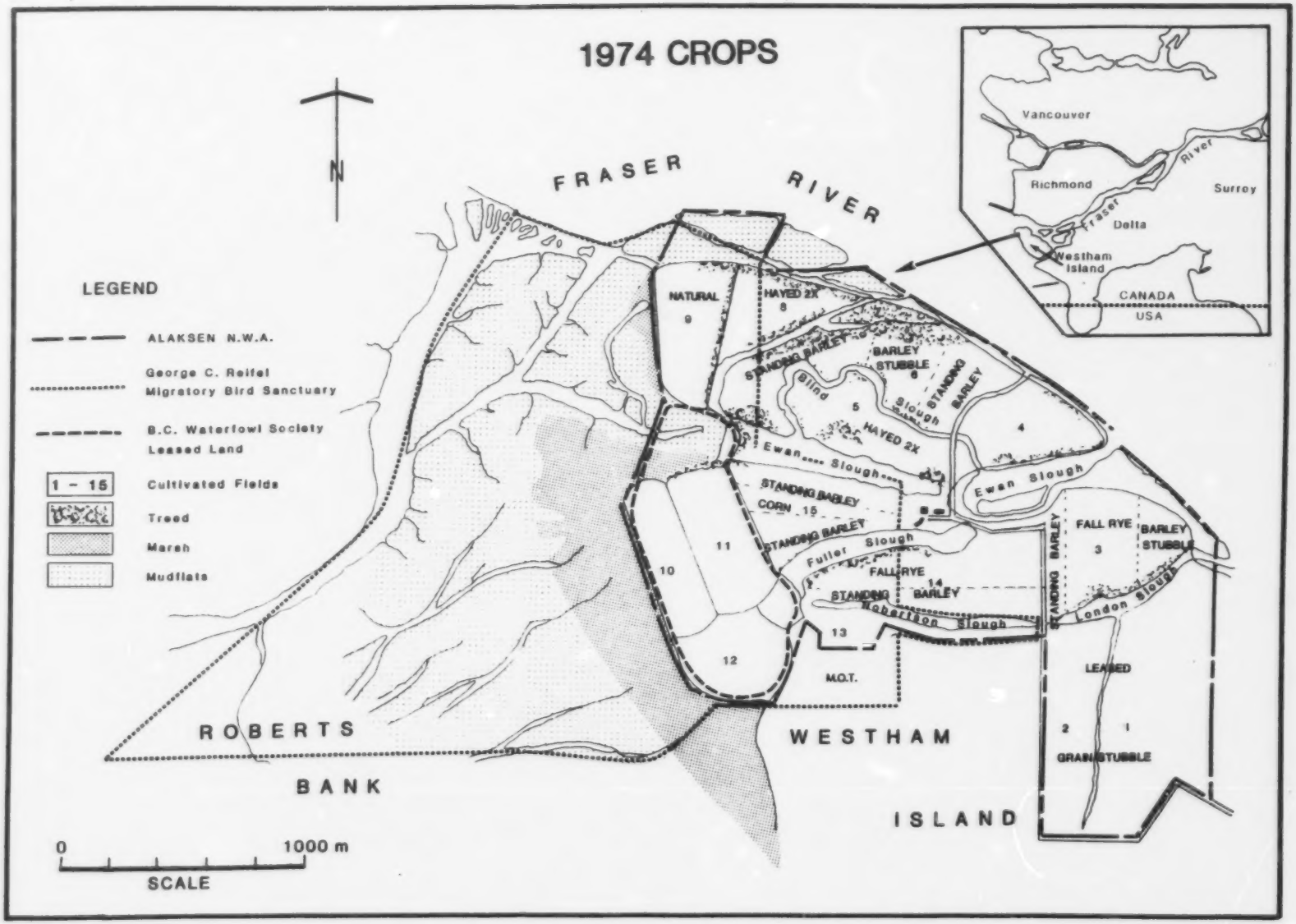
C.W.S. field notes.

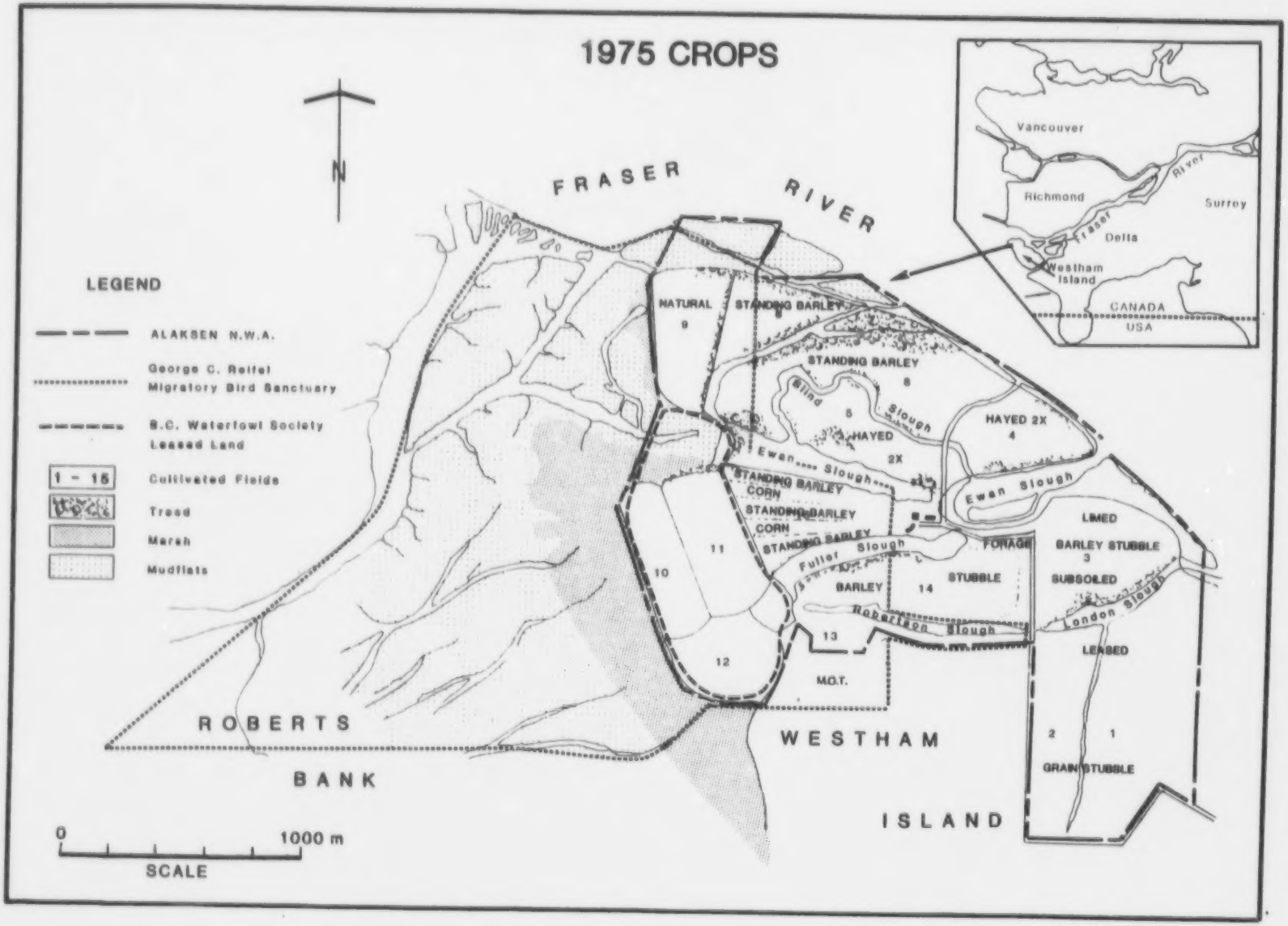
"March, 1977 - 2,000+ snows on Alaksen."

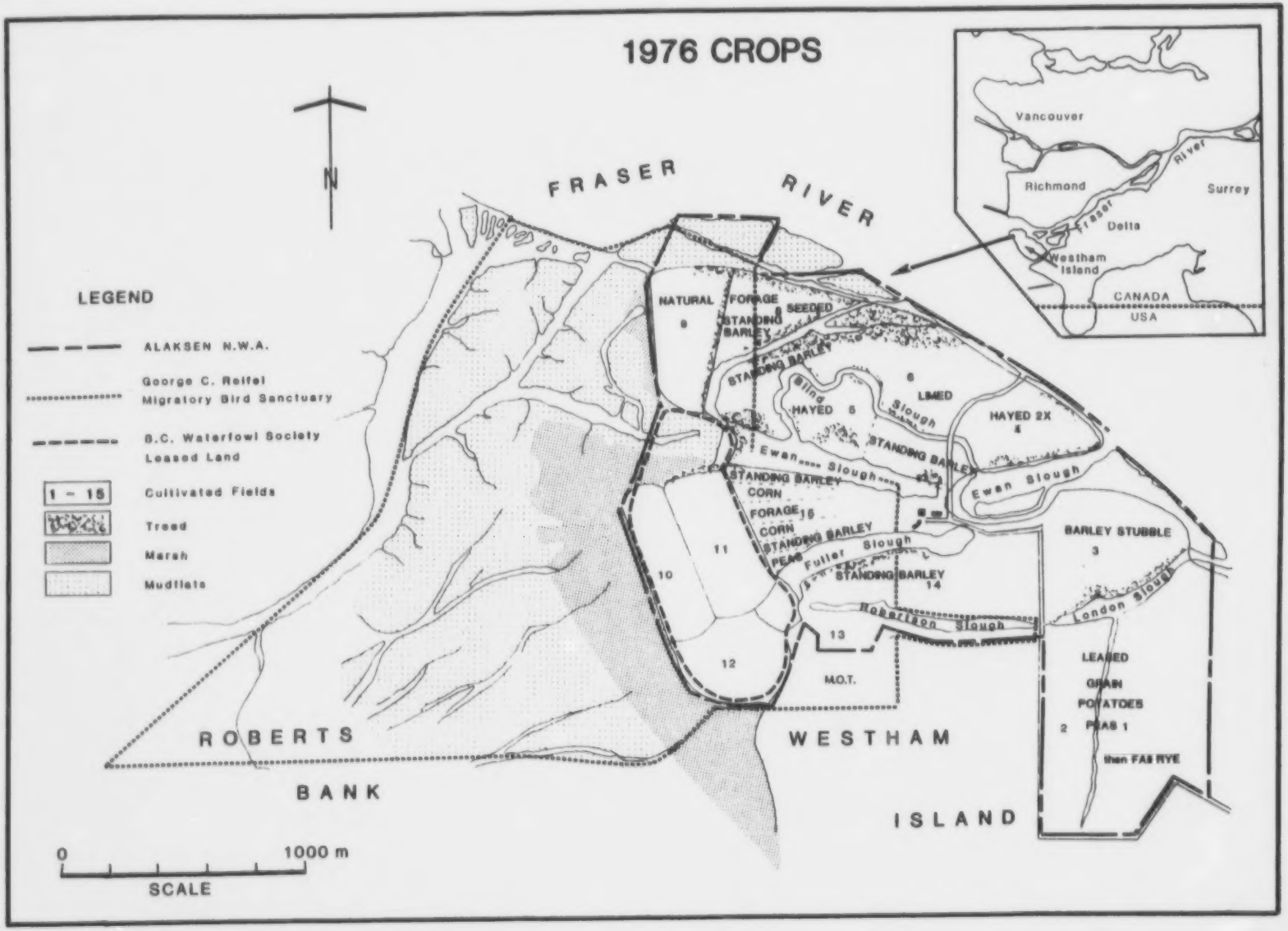
J.P. Hatfield field notes.

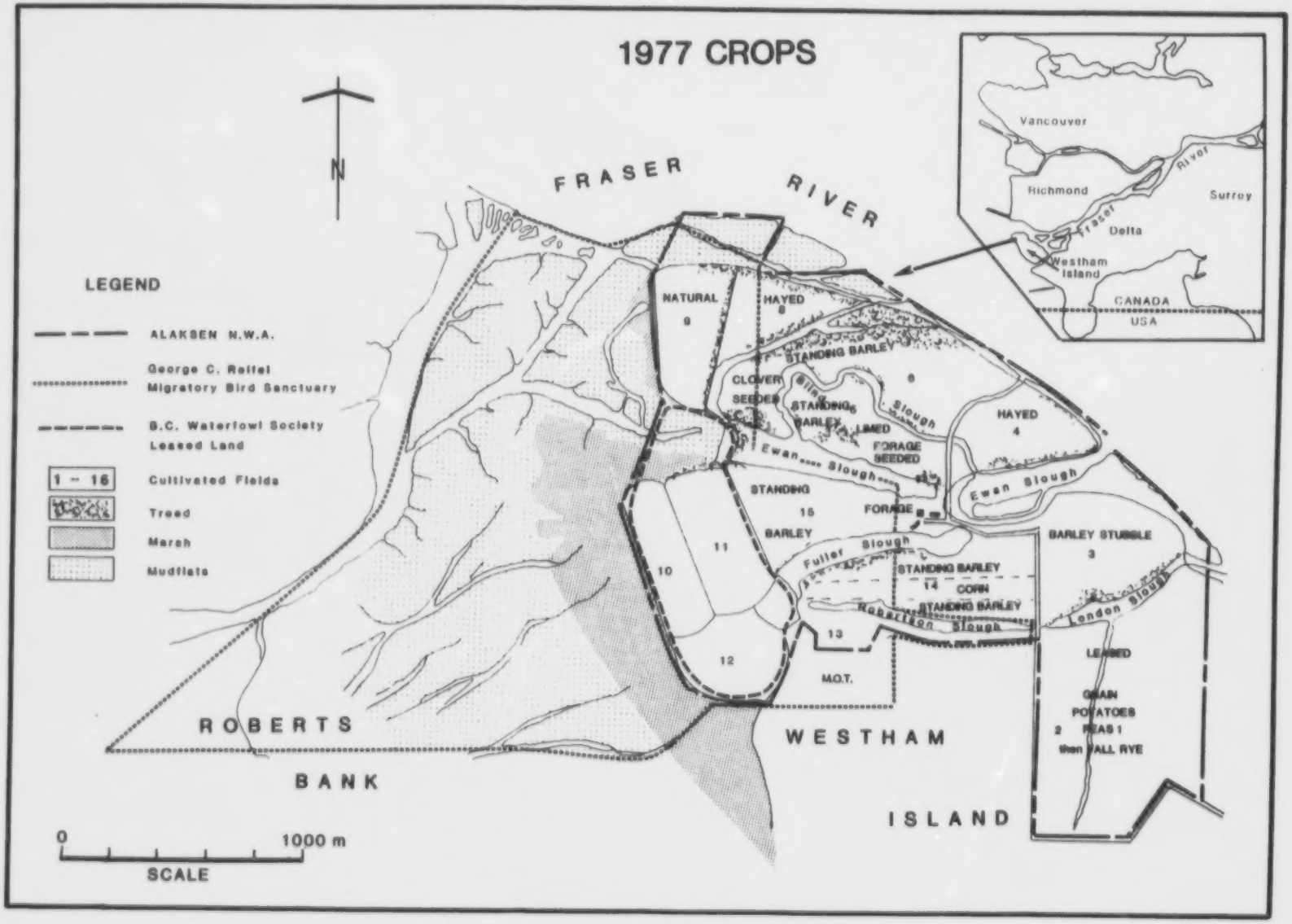
APPENDIX 4

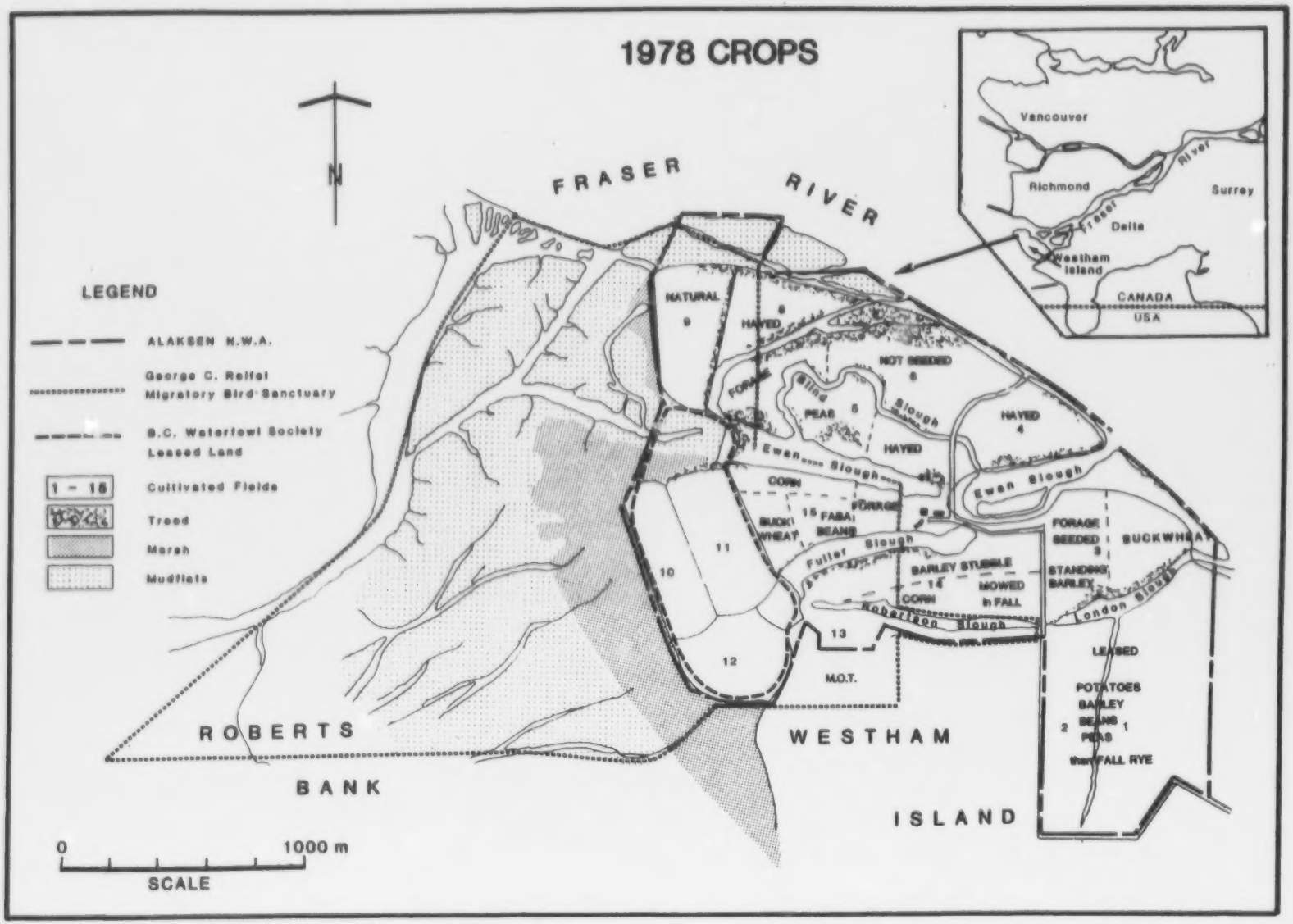
Maps showing field crops from 1974-1987


1974 CROPS
N
FRASER RIVER
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
NATURAL
HAYED 2X
STANDING BARLEY
BARLEY STUBBLE
Blind Slough
HAYED 2X
Ewan Slough
STANDING BARLEY
CORN
FALL RYE
BARLEY STUBBLE
Fuller Slough
STANDING BARLEY
Robertson Slough
London Slough
M.O.T.
LEASED
GRAIN STUBBLE
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE

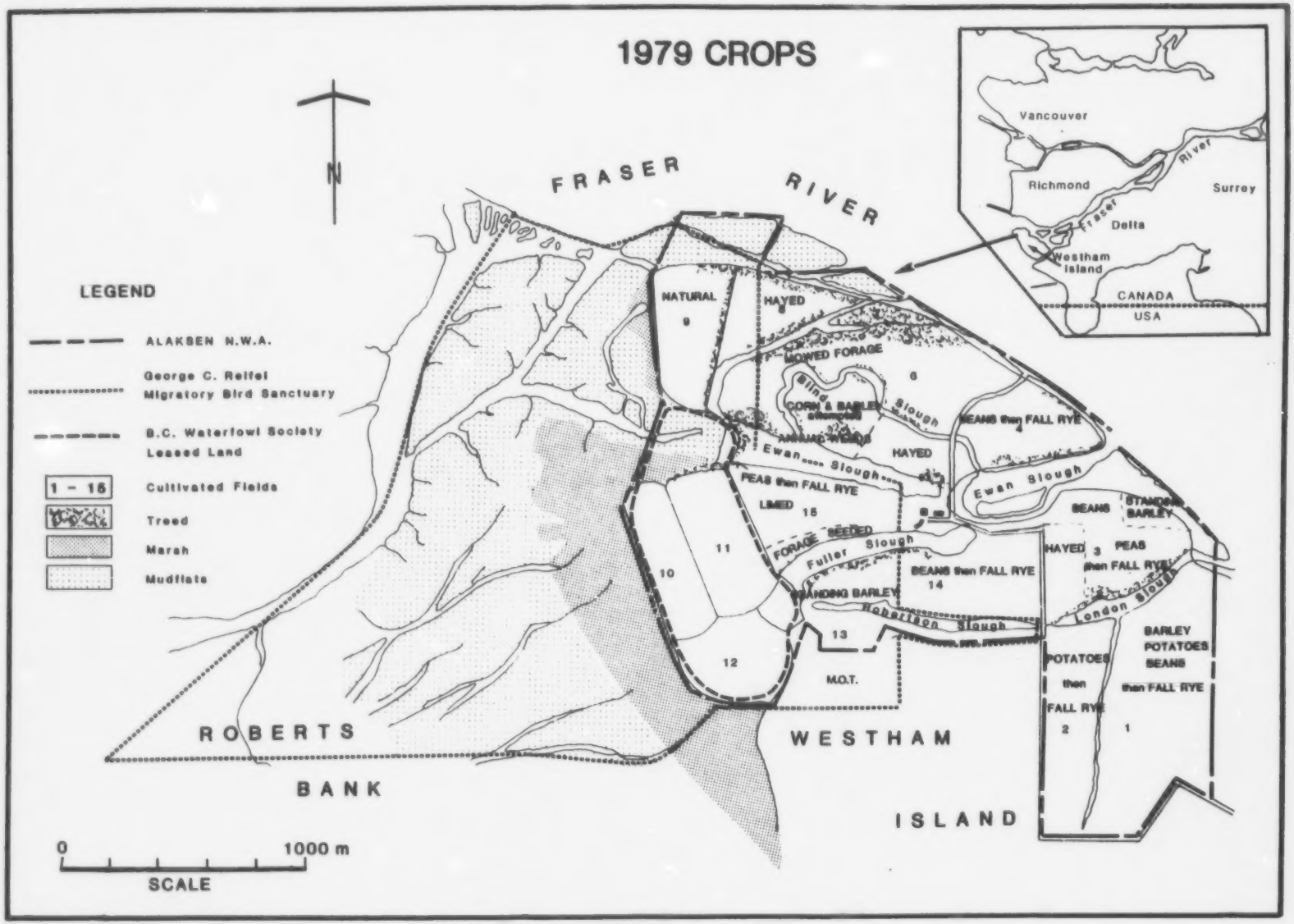

1975 CROPS
N
FRASER RIVER
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
NATURAL
9
STANDING BARLEY
STANDING BARLEY
8
Blind Slough
5
HAYED
2X
HAYED 2X
4
Ewan Slough
STANDING BARLEY
CORN
STANDING BARLEY
CORN
STANDING BARLEY
11
10
Fuller Slough
BARLEY
14
STUBBLE
FORAGE
LMED
BARLEY STUBBLE
3
SUBSOILED
Roberts Bank Slough
London Slough
13
12
M.O.T.
LEASED
2
1
GRAIN STUBBLE
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE

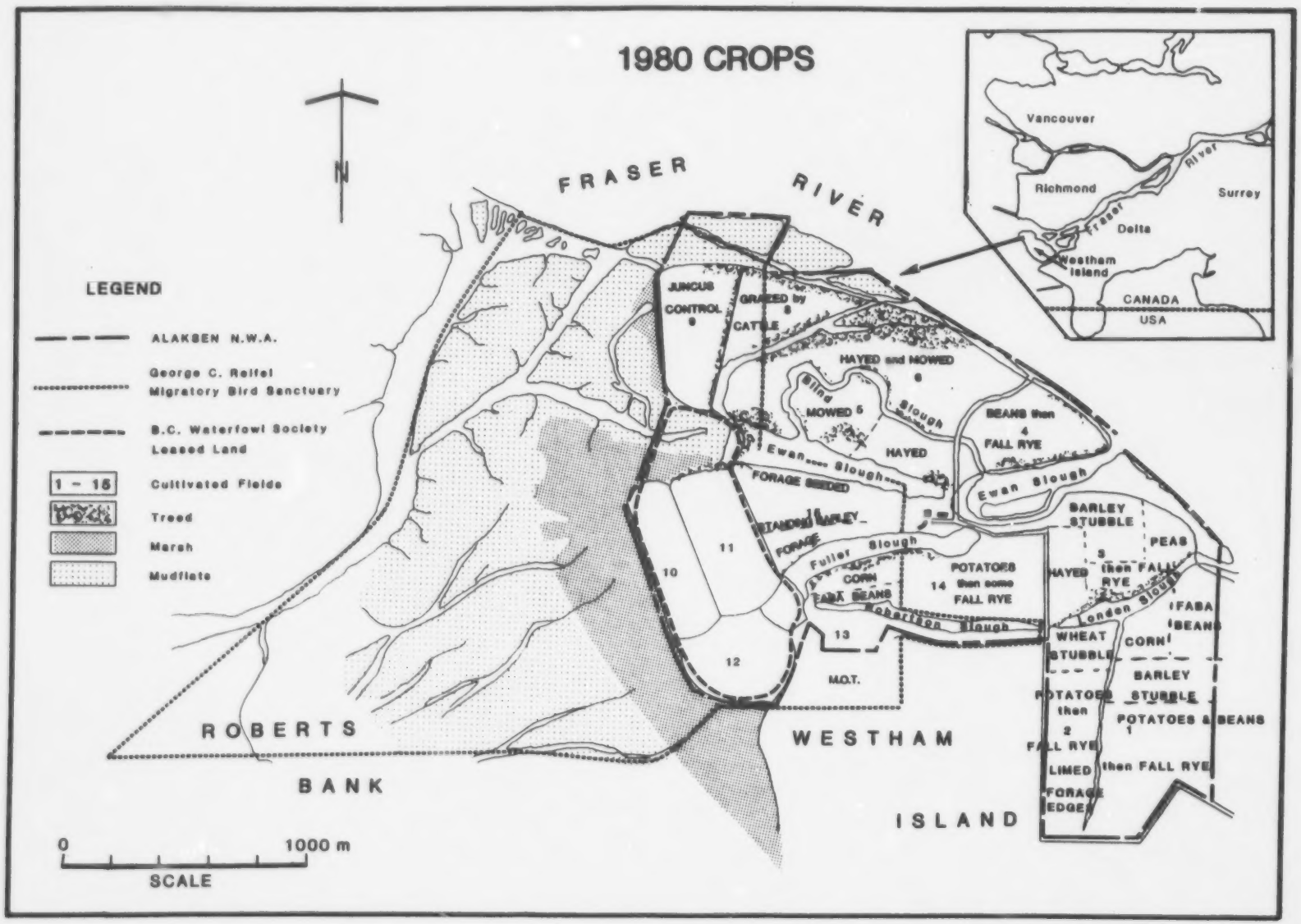

1976 CROPS
N
FRASER RIVER
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
NATURAL FORAGE 9
SEEDED 8
STANDING BARLEY
STANDING BARLEY
Silting Slough
LMED 6
HAYED 6
HAYED 2X 4
STANDING BARLEY
Ewan Slough
STANDING BARLEY
CORN
FORAGE 15
CORN
STANDING BARLEY
PEAS
Fuller Slough
STANDING BARLEY 14
Ewan Slough
BARLEY STUBBLE 3
Robertson Slough
London Slough
LEASED GRAIN POTATOES 2 PEAS 1 then FALL RYE
M.O.T.
10
11
12
13
ROBERTS BANK
WESTHAM ISLAND
0 1000 m
SCALE

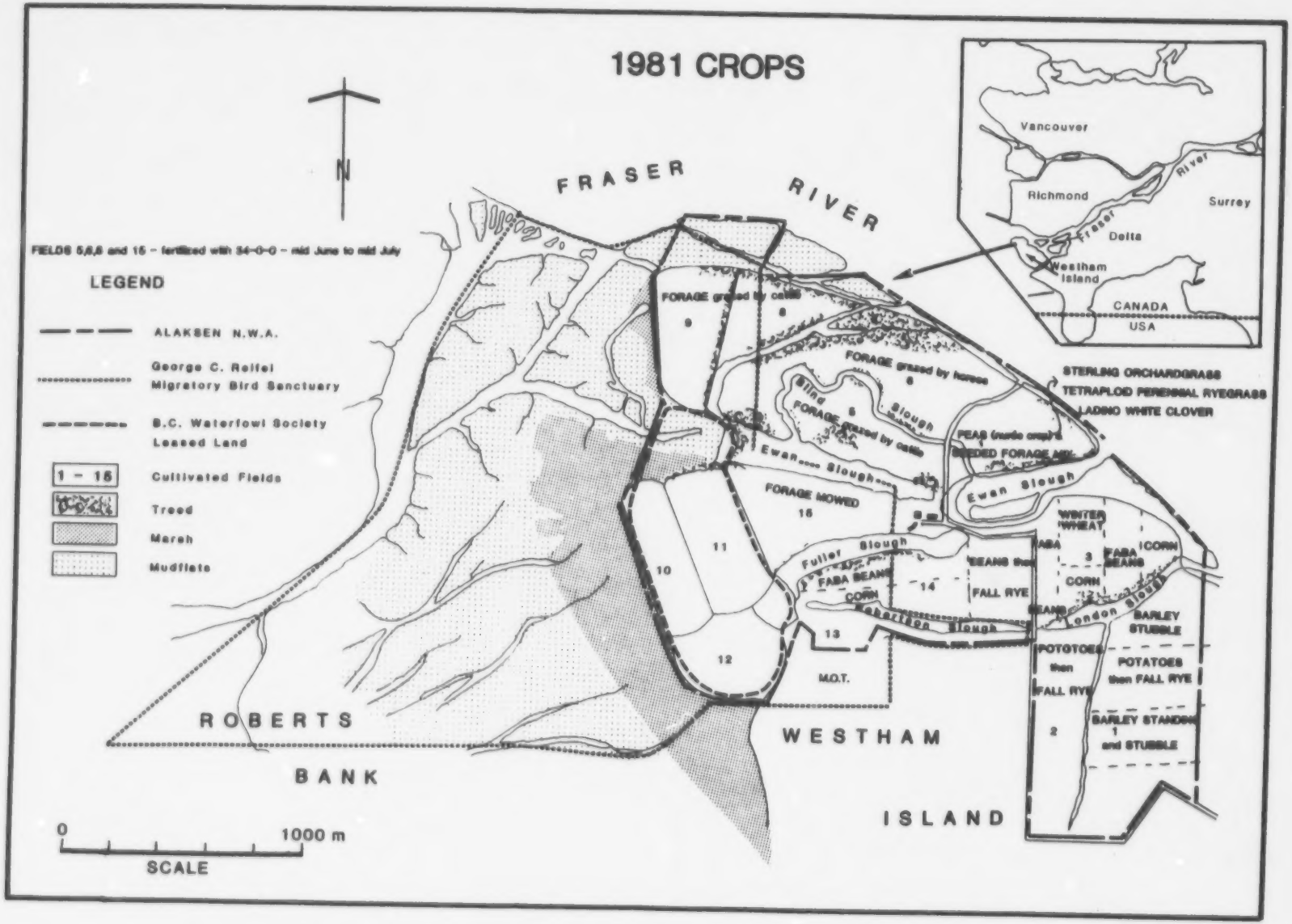

1977 CROPS
N
FRASER RIVER
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 16 Cultivated Fields
Treed
Marsh
Mudflats
NATURAL
9
HAYED
8
STANDING BARLEY
8
CLOVER SEEDED
STANDING BARLEY
LAYED
FORAGE SEEDED
Slough
Ewan Slough
HAYED
4
STANDING
15
BARLEY
FORAGE
11
10
12
Fuller Slough
STANDING BARLEY
14 CORN
STANDING BARLEY
Robertson Slough
13
M.O.T.
BARLEY STUBBLE
3
London Slough
LEASED
GRAIN
POTATOES
2 PEAS 1
then FALL RYE
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE

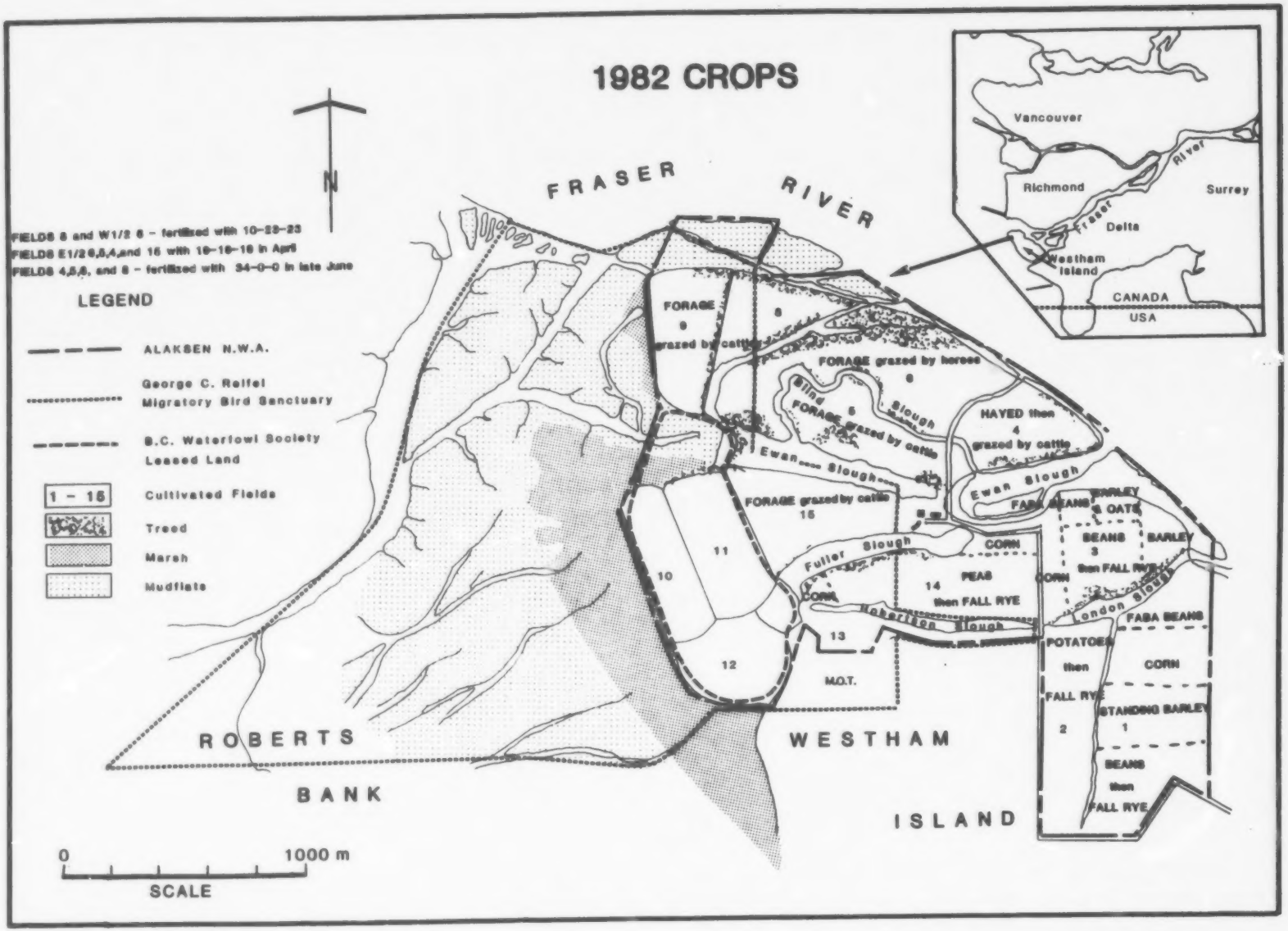

1978 CROPS
N
FRASER RIVER
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
NATURAL
HAYED
NOT SEEDED
FORAGE
PEAS
Ewan Slough
CORN
FORAGE
BUCKWHEAT
FABA BEANS
Fuller Slough
BARLEY STUBBLE
STANDING BARLEY
CORN
MOWED in FALL
Robertson Slough
London Slough
LEASED
POTATOES
BARLEY
BEANS
PEAS
FALL RYE
M.O.T.
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE

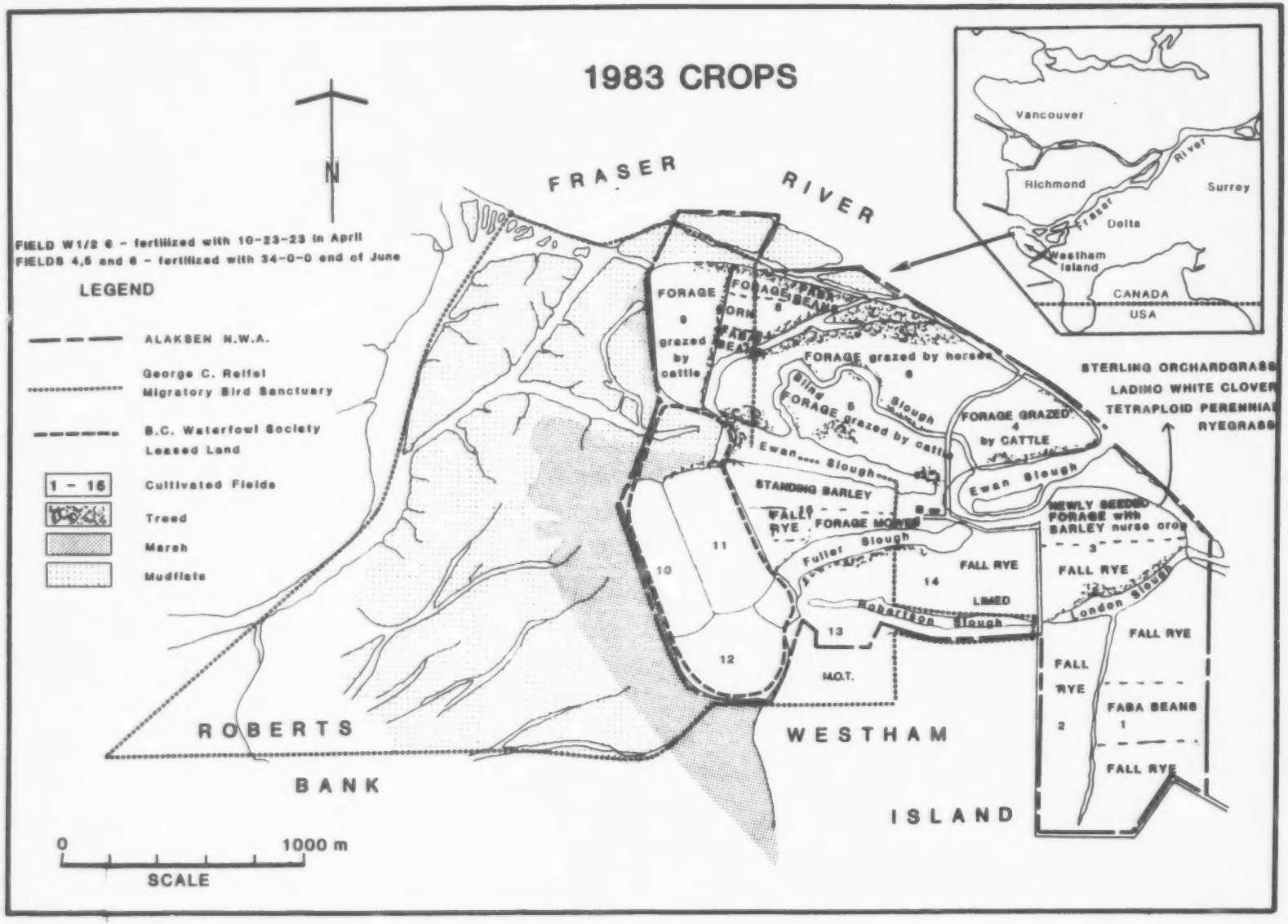
1978 CROPS

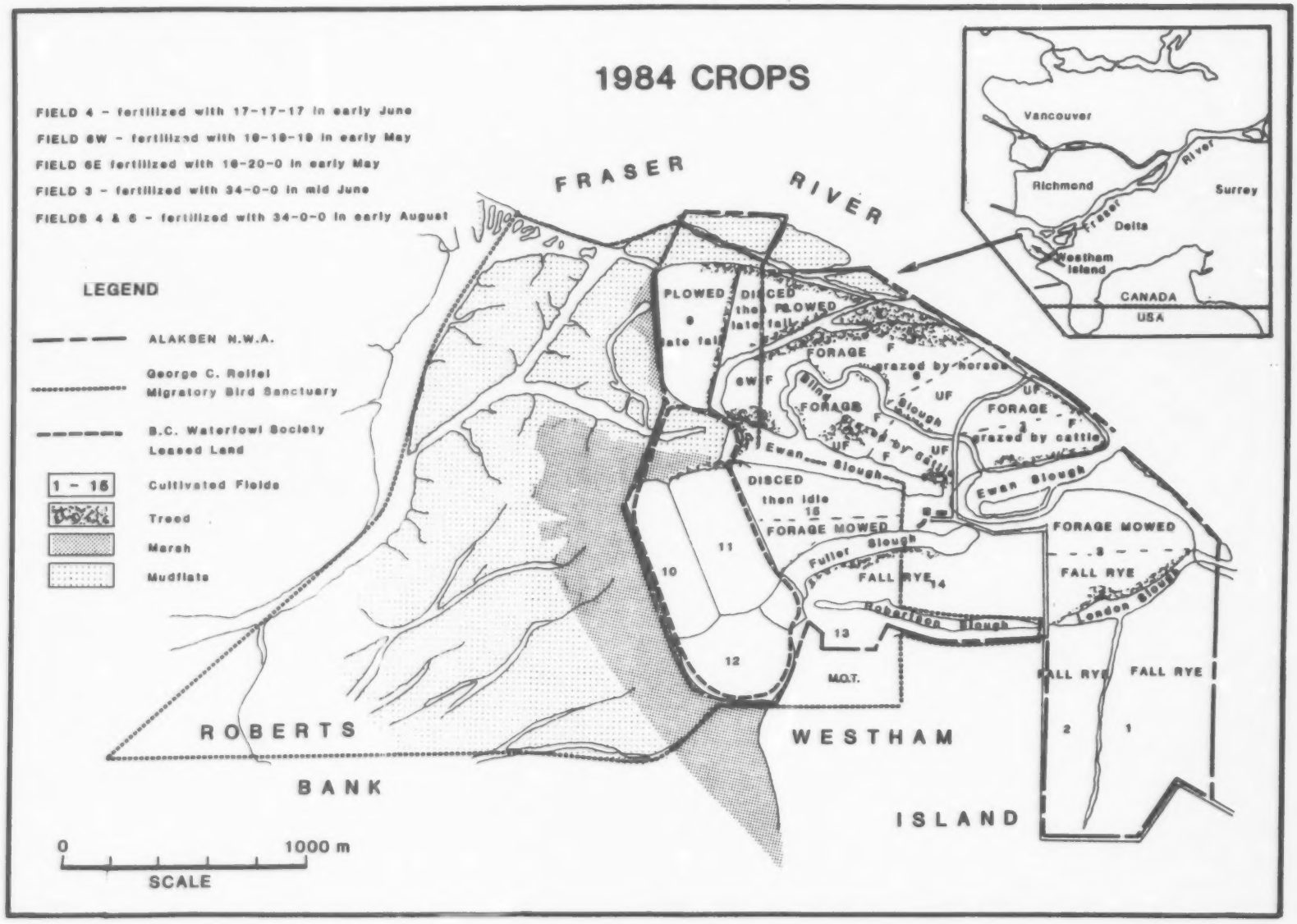

1979 CROPS
N
FRASER RIVER
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 16 Cultivated Fields
Treed
Marsh
Mudflats
NATURAL
HAYED
MOWED FORAGE
Sling Slough
CORN & BARLEY
BEANS then FALL RYE
Ewan Slough
PEAS then FALL RYE
LMED
FORAGE SEEDED
Fuller Slough
STANDING BARLEY
Robertson Slough
London Slough
BEANS
STANDING BARLEY
PEAS then FALL RYE
POTATOES then FALL RYE
BARLEY POTATOES BEANS
M.O.T.
ROBERTS BANK
WESTHAM ISLAND
0 1000 m
SCALE

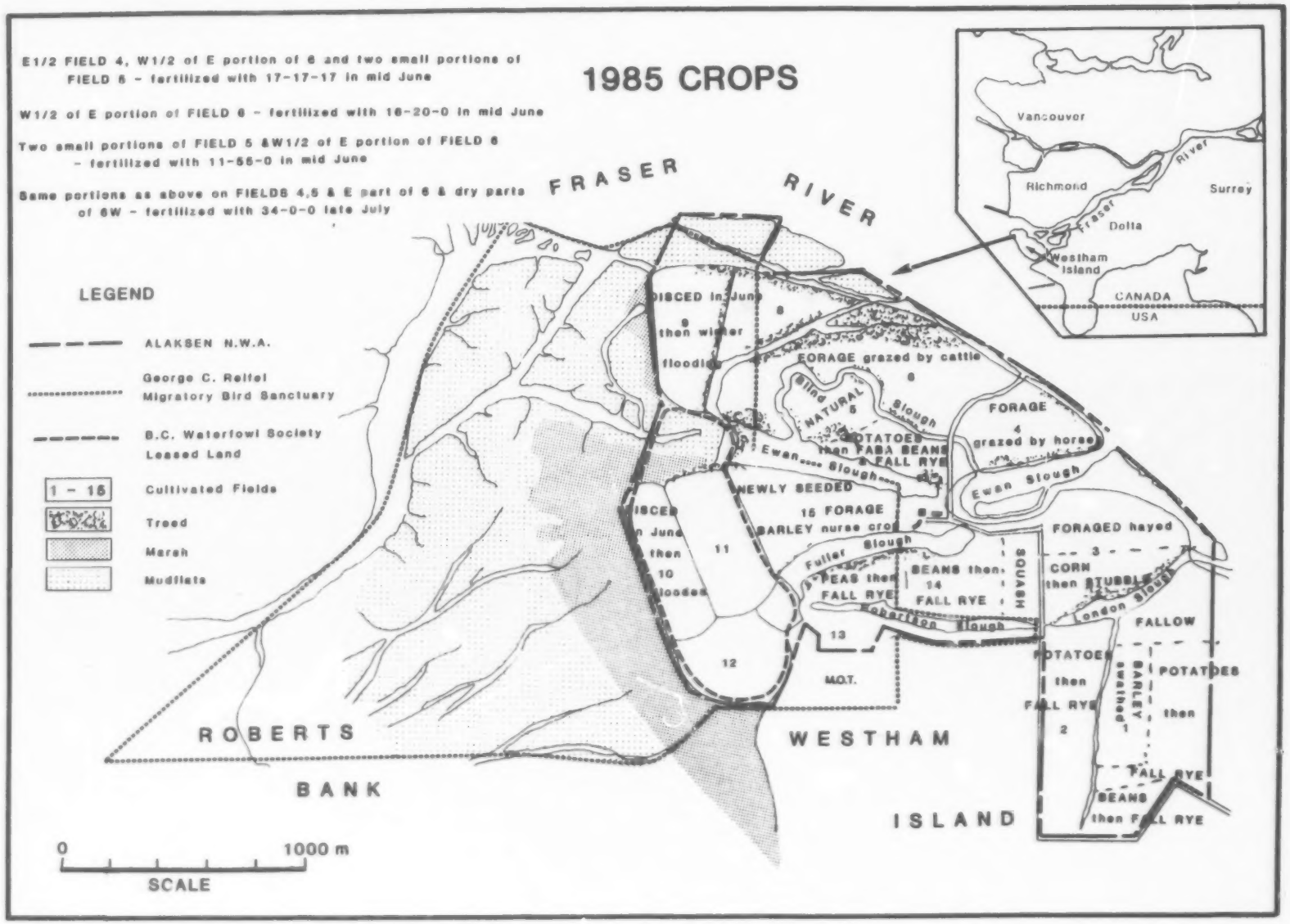

1980 CROPS
N
FRASER RIVER
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
JUNCUS CONTROL
GRAZED by CATTLE
HAYED and MOWED
MOWED 5
Ewan Slough
HAYED
BEANS then 4 FALL RYE
FORAGE SEEDED
STANDING BARLEY FORAGE
Fuller Slough
CORN
FABA BEANS
POTATOES 14 then some FALL RYE
Robertson Slough
BARLEY STUBBLE
PEAS
HAYED 5 then FALL RYE
London Slough
FABA BEANS
WHEAT STUBBLE
CORN
BARLEY STUBBLE
POTATOES then 2 FALL RYE
POTATOES & BEANS 1
LIMED then FALL RYE
FORAGE EDGE
10
11
12
13
M.O.T.
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE

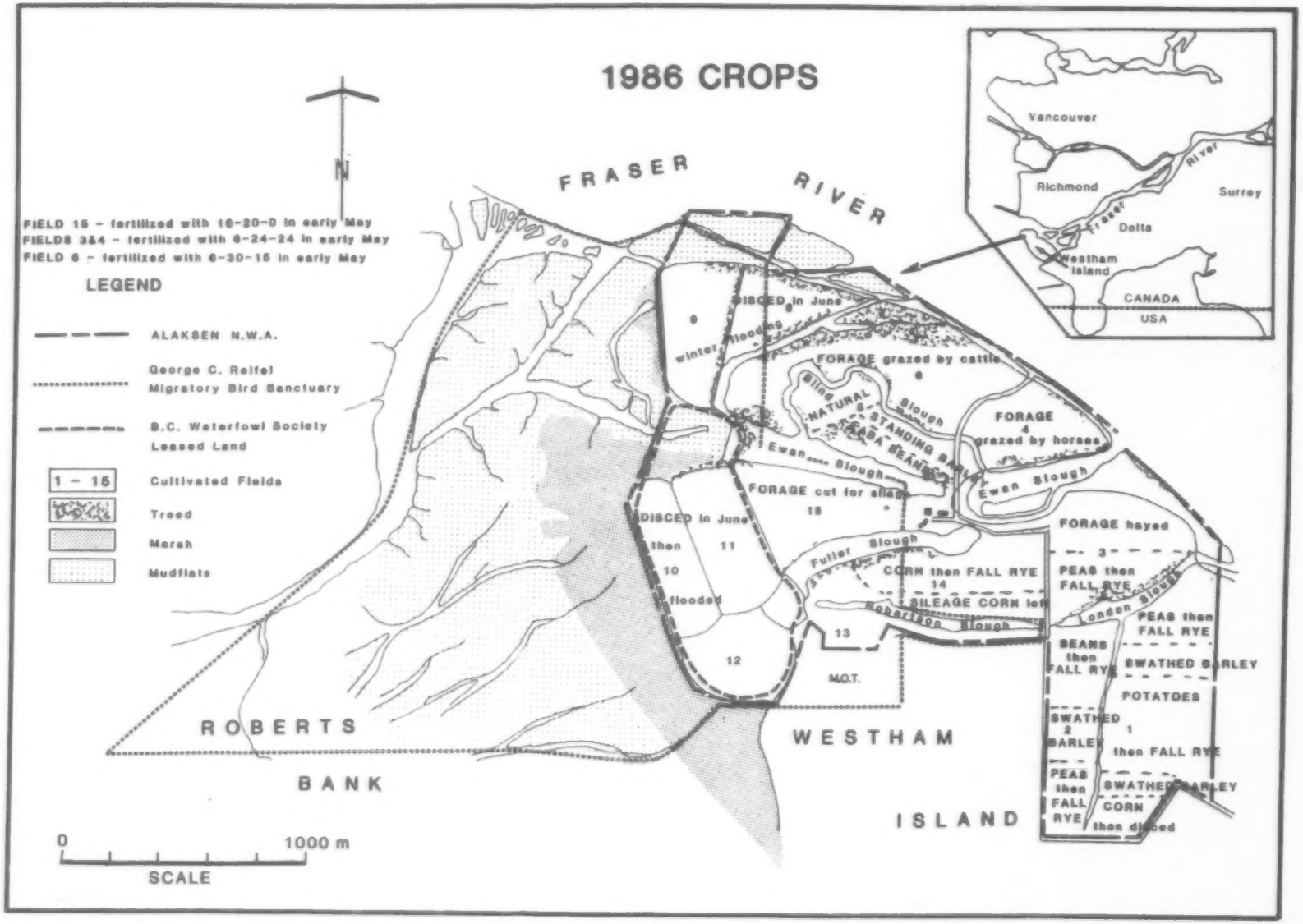

1981 CROPS
N
FRASER RIVER
FIELDS 5,8,9 and 15 - fertilized with 34-0-0 - mid June to mid July
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
FORAGE grazed by cattle
FORAGE grazed by horses
STERLING ORCHARDGRASS
TETRAPLOID PERENNIAL RYEGRASS
LADINO WHITE CLOVER
PEAS (nurse crop) & SEEDED FORAGE MIX
Ewan Slough
FORAGE MOWED
Fuller Slough
FABA BEANS
CORN
FALL RYE
WINTER WHEAT
BARLEY STUBBLE
POTATOES then FALL RYE
BARLEY STANDING and STUBBLE
M.O.T.
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE

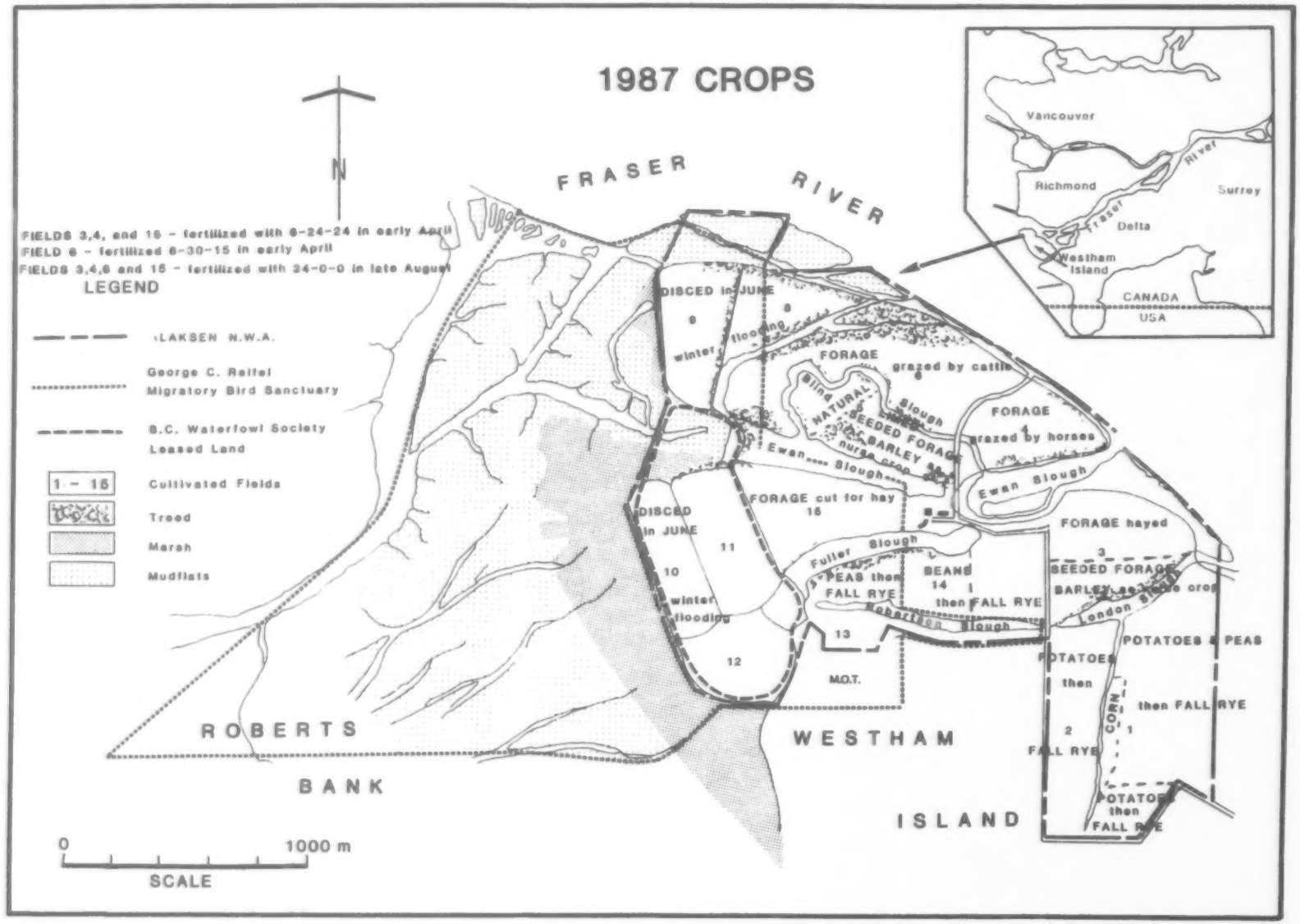

1982 CROPS
N
FIELDS 8 and W1/2 6 - fertilized with 10-23-23
FIELDS E1/2 6,5,4,and 16 with 16-16-16 in April
FIELDS 4,5,6, and 8 - fertilized with 34-0-0 in late June
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 16 Cultivated Fields
Treed
Marsh
Mudflats
FRASER RIVER
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
FORAGE grazed by cattle
FORAGE grazed by horses
Blind Slough
HAYED then grazed by cattle
Ewan Slough
FABA BEANS
BARLEY & OATS
BEANS
BARLEY
then FALL RYE
CORN
PEAS
then FALL RYE
Fuller Slough
Roberts Slough
London Slough
FABA BEANS
POTATOES then FALL RYE
CORN
STANDING BARLEY
BEANS then FALL RYE
M.O.T.
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE


1983 CROPS
N
FRASER RIVER
FIELD W1/2 6 - fertilized with 10-23-23 in April
FIELDS 4,5 and 6 - fertilized with 34-0-0 end of June
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 16 Cultivated Fields
Treed
Marsh
Mudflats
FORAGE 6 grazed by cattle
FORAGE grazed by horses 6
Blind Slough
FORAGE 5 grazed by cattle
FORAGE GRAZED 4 by CATTLE
Ewan Slough
STANDING BARLEY
FALL RYE FORAGE MOWED
Fuller Slough
FALL RYE 14
LIMED
Robertson Slough
13
M.O.T.
12
11
10
STERLING ORCHARDGRASS
LADINO WHITE CLOVER
TETRAPLOID PERENNIAL RYEGRASS
NEWLY SEEDED FORAGE with BARLEY nurse crop 3
FALL RYE 12
London Slough
FALL RYE
FALL RYE
FABA BEANS 1
2
FALL RYE
ROBERTS BANK
WESTHAM ISLAND
0 1000 m
SCALE
Vancouver
Richmond
Surrey
Fraser River
Fraser Delta
Westham Island
CANADA
USA


1984 CROPS
FIELD 4 - fertilized with 17-17-17 in early June
FIELD 6W - fertilized with 18-18-18 in early May
FIELD 6E fertilized with 18-20-0 in early May
FIELD 3 - fertilized with 34-0-0 in mid June
FIELDS 4 & 6 - fertilized with 34-0-0 in early August
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
FRASER RIVER
ROBERTS BANK
WESTHAM ISLAND
PLOWED
DISCED then PLOWED late fall
FORAGE
grazed by horses
grazed by cattle
Ewan Slough
DISCED then idle
FORAGE MOWED
Fuller Slough
FALL RYE
Robertson Slough
London Slough
M.O.T.
0 1000 m
SCALE
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA


1985 CROPS
E1/2 FIELD 4, W1/2 of E portion of 6 and two small portions of FIELD 5 - fertilized with 17-17-17 in mid June
W1/2 of E portion of FIELD 6 - fertilized with 16-20-0 in mid June
Two small portions of FIELD 5 &W1/2 of E portion of FIELD 6 - fertilized with 11-55-0 in mid June
Same portions as above on FIELDS 4,5 & E part of 6 & dry parts of 6W - fertilized with 34-0-0 late July
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
FRASER RIVER
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
FORAGE grazed by cattle
NATURAL
POTATOES then FABA BEANS & FALL RYE
FORAGE grazed by horses
Ewen Slough
NEWLY SEEDED
15 FORAGE
BARLEY nurse crop
Fuller Slough
PEAS then FALL RYE
BEANS then FALL RYE
Robertson Slough
FORAGED hayed
CORN then STUBBLE
London Slough
FALLOW
POTATOES then FALL RYE
BARLEY seeding
POTATOES then
FALL RYE
BEANS then FALL RYE
M.O.T.
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE


1986 CROPS
N
FIELD 15 - fertilized with 16-20-0 in early May
FIELDS 3&4 - fertilized with 6-24-24 in early May
FIELD 6 - fertilized with 6-30-15 in early May
LEGEND
ALAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
FRASER RIVER
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
DISCED in June
winter flooding
FORAGE grazed by cattle
Bilina Slough
NATURAL & STANDING GRASS & BEANS
FORAGE 4 grazed by horses
Ewen Slough
FORAGE cut for silage 15
DISCED in June then 10 flooded
11
Fuller Slough
CORN then FALL RYE 14
SILEAGE CORN left
Roberts Slough
13
12
M.O.T.
FORAGE hayed 3
PEAS then FALL RYE
London Slough
PEAS then FALL RYE
BEANS then FALL RYE
SWATHED BARLEY
POTATOES
SWATHED BARLEY 2
1
then FALL RYE
PEAS then FALL RYE
SWATHED BARLEY
CORN then disced
ROBERTS BANK
WESTHAM ISLAND
0
1000 m
SCALE


1987 CROPS
N
FRASER RIVER
FIELDS 3,4, and 15 - fertilized with 6-24-24 in early April
FIELD 6 - fertilized 6-30-15 in early April
FIELDS 3,4,6 and 15 - fertilized with 34-0-0 in late August
LEGEND
LAKSEN N.W.A.
George C. Reifel Migratory Bird Sanctuary
B.C. Waterfowl Society Leased Land
1 - 15 Cultivated Fields
Treed
Marsh
Mudflats
Vancouver
Richmond
Surrey
Fraser River
Delta
Westham Island
CANADA
USA
DISCED in JUNE
winter flooding
FORAGE grazed by cattle
Blind Slough
NATURAL SEEDED FORAGE BARLEY nurse crop
FORAGE grazed by horses
Ewan Slough
FORAGE cut for hay
DISCED in JUNE
Fuller Slough
PEAS then FALL RYE
BEANS then FALL RYE
FORAGE hayed
SEEDED FORAGE
BARLEY as a nurse crop
London Slough
Robertson Slough
POTATOES & PEAS
POTATOES then FALL RYE
CORN
POTATOES then FALL RYE
M.O.T.
ROBERTS BANK
WESTHAM ISLAND
0 1000 m
SCALE